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SELECTIVE ANALYTICAL HYDROGENATION OF OLEFINIC DISTILLATES *

By H. I. WATERMAN † (Hon. Fellow), A. B. R. WEBER †, and C. ZWEEKHORST †

SUMMARY

The analytical hydrogenation of two kerosine fractions in a rotating autoclave with different catalysts is described. The hydrogenations were mostly carried out at 10 and 100 atm initial pressure, one hour reaction time at 20°–300° C, and with a catalyst to oil ratio of 1 : 4. For judging the hydrogenation the starting materials and hydrogenated oils were selectively separated into aromatics, olefins, and saturates with silica gel according to the Fluorescent Indicator Adsorption Method. In the experiments a hydrogenation was considered to be selective when the volume percentage aromatics had not changed, while the volume percentage olefins was smaller than 1 (bromine value <1). From the experiments it appeared that, even at low temperatures, nickel on kieselguhr and palladium on active carbon are not strictly selective. Raney nickel and a platforming catalyst are not selective either, both catalysts hydrogenating a definite small portion of the aromatics at low temperatures. Selective hydrogenation of the fractions was possible with molybdenum on active carbon (100 atm and 300° C) and with platinum on silica–alumina (10 atm and 120° C).

INTRODUCTION

IN analytical hydrogenation of oil fractions difference must be made between "total" and "selective" hydrogenation. In total hydrogenation both olefins and aromatics in the sample are converted into saturated compounds, while a hydrogenation is called selective when only olefins in the sample are hydrogenated. As the total hydrogenation of petroleum fractions is an important operation for evaluating their constitution,[1] several investigators have studied this matter.

In 1935, Vlugter, Waterman, and van Westen [2] described the total hydrogenation of petroleum fractions in a rotating autoclave at 250°–300° C and 200 atm hydrogen pressure, using nickel on kieselguhr as catalyst. The catalyst to oil ratio was 1 : 1000. In 1938, Mair, Willingham, and Streiff [3] described the API 6 hydrogenation procedure with Raney nickel at 250° C and 200 atm pressure. The catalyst to oil ratio was 2 : 1. In practice it appeared, however, that a complete saturation of aromatics was difficult, especially for high-boiling samples. In these cases repeated hydrogenations, each time with fresh catalyst, were necessary.

Waterman and van Vlodrop [4] improved their method in 1940, by using a catalyst to oil ratio of 1 : 1 or more, resulting in a complete hydrogenation in a limited number of operations, *e.g.* three. In 1951, Lipkin, Martin, and Worthing [5] also described an improved procedure, in which a solution of the sample was charged to the autoclave at the hydrogenation temperature. Using Raney nickel with a catalyst to oil ratio of 10 : 1, complete saturation of high-boiling petroleum fractions was attained, after two hydrogenations at 250° C and 200 atm pressure.

Most of the modern methods for type carbon atom analysis of petroleum fractions require olefin-free samples.[1] As many reforming and cracking processes yield olefinic distillates, selective hydrogenation of such fractions can be useful in making them suitable for analysis. In 1928, Waterman, Perquin, and van Westen [6] completely hydrogenated pentene with a palladium catalyst at room temperature and atmospheric pressure, whereas benzene under these conditions was not hydrogenated. In 1935, Vlugter [7] hydrogenated cracked distillates with a molybdenum catalyst at 300° C and 100 atm initial pressure, and showed that only olefins were hydrogenated under these conditions, aromatics being unchanged. Vlugter also pointed out that in the case of very unsaturated gasolines some side polymerization and condensation accompany the hydrogenation. In such cases a two-stage procedure was recommended. In the first stage the very unstable unsaturates were hydrogenated with nickel on kieselguhr (100 atm initial pressure, 150° C, catalyst to oil ratio 1 : 10). In the second stage the product of the first stage was further hydrogenated with the molybdenum catalyst in the same manner as for the one-stage process.

In 1936, de Kok, Waterman, and van Westen [8] hydrogenated unsaturates at 20° C and atmospheric pressure in the presence of palladium on active carbon. Olefins, di-olefins, and *cyclo*-olefins were completely hydrogenated, whereas styrene was hydrogenated to ethylbenzene.

In 1938, Ipatieff and Corson [9] described the selective hydrogenation of a mixture of olefins and aromatics with a nickel on kieselguhr catalyst at 20°–50° C and high hydrogen pressure. A recent investigation of Miron in 1955 [10] describes the selective hydrogenation of petroleum fractions with a nickel on kieselguhr catalyst (catalyst to oil ratio 1 : 5, 130° C, and high hydrogen pressure).

The present investigation was carried out in order to compare the selectivity of some common catalysts and to find a selective hydrogenation procedure, in order to saturate olefinic double bonds in residual fractions, obtained by platforming of medicinal oil (*paraffinum liquidum*).

* MS received 14 June 1956.

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EXPERIMENTAL PART

Starting Materials

Commercial colourless medicinal oil (average mol. wt. 370, density 0·8707, sulphur content zero) was vaporized with hydrogen and contacted with 300 ml of a platforming catalyst in a semi-technical installation, which has been described in a former paper.[17] The reaction conditions were varied between 0·9 and 2·3 WHSV, 450° and 510° C, 20 and 60 atm hydrogen pressure, and molar ratios (H_2-oil) 17 and 48. It appeared that extensive dehydrogenation and hydrocracking of the feedstock took place. Some of the reaction products were distilled and the fractions boiling from 200° to 260° C separated and combined. In this way two samples were prepared, which were used as starting materials for the analytical hydrogenation experiments. Table I shows data on molecular weight, bromine value, and the hydrocarbon type of the two samples.

Preparation of Catalysts

(1) *Nickel on Kieselguhr.*[11]—Soda was added to a warm solution of nickel sulphate, containing kieselguhr. After boiling some time, the mass was filtered hot and washed sulphate free. After drying, the material was reduced in a hydrogen flow at 420°–500° C. The catalyst contained 16 per cent nickel.

(2) *Raney Nickel.*[12]—A nickel–aluminium alloy (50 per cent Ni) in powder form was treated with a concentrated solution of caustic soda. Aluminium dissolved as aluminate, and the remaining active nickel was thoroughly washed and dried.

(3) *Molybdenum on Active Carbon.*[7]—Hydrogen sulphide was passed through a sulphuric acid solution of ammonium molybdate. To the resulting molybdenum sol active carbon was added. After filtering, the catalyst was washed and dried at 100° C. The catalyst contained 16 per cent molybdenum.

(4) *Palladium on Active Carbon.*[13]—A solution of palladium chloride in diluted hydrochloric acid was impregnated on active carbon. After evaporating, the catalyst was dried at 100° C. The catalyst contained 5 per cent palladium.

(5) *Platforming Catalyst.*[14]—Aluminium *iso*-propylate was hydrolysed in boiling water and diluted hydrochloric acid added to the suspension. A colloidal solution of platinum sulphide was prepared by passing hydrogen sulphide through a solution of chloroplatinic acid in water. The resulting colloidal solution was thoroughly mixed with the aluminium hydroxide suspension and the combined solution oxidized with hydrogen peroxide. After evaporating the water, the mass was dried at 90° C for 14 hours, heated at 160° C for 14 hours, and calcined at 600° C for 12 hours. The resulting catalyst contained 0·1 per cent platinum and 1·5 per cent chlorine. In the hydrogenation experiments each portion of catalyst was heated at 580° C during one hour prior to use.

(6) *Platinum on Silica–Alumina.*[15]—A solution of chloroplatinic acid in water was adsorbed on commercial silica–alumina cracking catalyst. The material was dried at 100° C for 16 hours and reduced in a hydrogen flow at 580° C for 16 hours. The catalyst contained 0·5 per cent platinum.

Hydrogenation Procedure

The experiments were carried out in a rotating autoclave of 120 ml capacity, to which 10 ml oil and 2 g catalyst were charged. After closing and evacuating the autoclave, hydrogen was introduced to the desired initial pressure and the autoclave heated up to the reaction temperature with gas burners. This temperature was kept constant within 3° C for one hour. After cooling, the autoclave was opened, emptied, and rinsed with small portions of olefin-free pentane. The hydrogenation mixture and rinsings were filtered and the catalyst thoroughly washed with pentane. After distilling the solvent, the last traces of pentane were stripped with nitrogen at room temperature and 10 cm mercury. In all experiments a recovery of at least 95 per cent was obtained.

Method of Analysis

The starting materials and hydrogenated oils were analysed for their volume percentages of aromatics, olefins, and saturates according to the Fluorescent Indicator Adsorption Method as described by Criddle and Le Tourneau.[16] In this chromatographic procedure the three hydrocarbon classes are separated with silica gel in a capillary tube by the direct displacement method. A dye mixture, which is added to the sample, makes the three hydrocarbon classes clearly visible under ultra-violet illumination.

By measuring the lengths of the sections in the tube, and dividing these lengths by the total length of the sample, the volume percentages are determined. In the analysis duplicate runs were always made, the results of which differed not more than 1 volume per cent. In this investigation Davison silica gel, Code 923 (100–200 mesh), was used, while the mixed indicator dye was supplied by Patent Chemicals Inc., 335 McLean Blvd., Paterson 4, N.J., U.S.A. For the starting materials and some of the hydrogenated products bromine values were determined according to the modified McIlhiney method.[18]

Criterion of Selective Hydrogenation

In this investigation a hydrogenation was considered to be selective when the volume percentage of olefins in the sample had become smaller than one unit (bromine value <1), while the volume percentage of aromatics had remained constant.

With regard to this criterion, attention must be drawn to the following points:

(1) It is not strictly correct to consider the change in volume percentages as representative

for the change in quantity. In the case of selective hydrogenation the volume of the sample increases, which results in a decrease of the volume percentage of aromatics, while the quantity has not changed.

However, it can easily be calculated from an example with pure compounds that this effect can be neglected for the investigated oils. Even in the case of considerable hydrogenation of aromatics this effect is of the order of one percentage unit.

(2) For the investigated oils a bromine value of one unit corresponds to 1 volume per cent of olefins. As a bromine value of one unit is tolerated in type carbon atom analysis, a volume percentage of olefins of one unit was also tolerated in the criterion.

(3) As aromatic olefins are classified as aromatics, the F.I.A. analysis gives no information about the hydrogenation of olefinic double bonds in aromatic side chains.

However, it is reasonable to assume that the olefinic saturation of aromatic olefins is as complete as the saturation of other olefins. Furthermore, one can prove the complete saturation of all olefinic double bonds at selective conditions by determining the bromine value.

(4) As the F.I.A. method classifies partially hydrogenated polycyclic aromatics as aromatics, no information could be obtained with this method about the partial saturation of polycyclic aromatics. Additional analysis should be carried out at selective conditions to prove that a strictly selective hydrogenation has occurred.

DISCUSSION OF RESULTS

In Table I the two starting materials are described.

Table II shows the conditions and results of the experiments. In Figs 1–8 the composition of the hydrogenated oils is shown and can be compared with the composition of the starting materials.

From the experiments with nickel on kieselguhr catalyst (Expts 1–3 and Figs 1–3), it appears that this catalyst is not suitable for selective hydrogenation of the fractions. From Fig 2 it appears that even at room temperature olefins are not selectively hydrogenated, while a considerable non-selective hydrogenation of the sample takes place at temperatures above 80° C (Figs 1 and 3).

From the experiments with molybdenum on active carbon (Expt 4, Fig 4), it appears that at 300° C the fraction is selectively hydrogenated. This result is in close agreement with the observations of Vlugter.[7] A drawback of this procedure is that side polymerization of olefins and partial hydrogenation of polycyclic

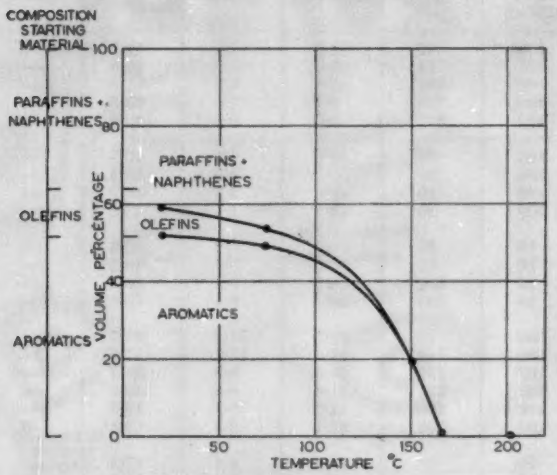

FIG 1

NICKEL ON KIESELGUHR CATALYST
100 atm initial hydrogen pressure
1 hr reaction time

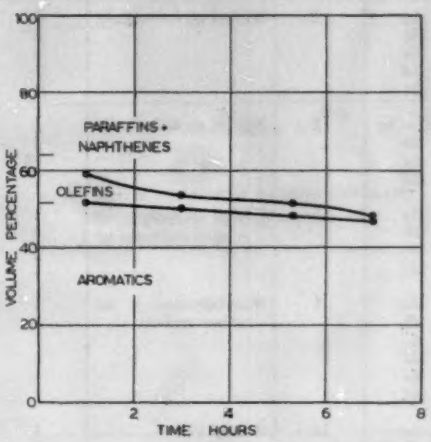

FIG 2

NICKEL ON KIESELGUHR CATALYST
Reaction temp 20° C
100 atm initial hydrogen pressure

TABLE I

Composition Starting Materials

Starting material no.	Boiling range, °C	Vol % aromatics	Vol % olefins	Vol % paraffins + naphthenes	Bromine value	Mean molecular weight
1	200–260	51·6	12·4	36·0	12	170
2	200–260	47·1	16·2	36·7	16	165

TABLE II

Conditions and Experimental Results

Expt no.	Starting material no.	Conditions of hydrogenation				Analysis hydrogenation products			
		Catalyst	Reaction time, hr	Initial pressure, atm (20° C)	Reaction temp, ° C	Vol % aromatics	Vol % olefins	Vol % paraffins + naphthenes	Bromine value
1*a*	I	Nickel on kieselguhr	1	100	20	51·8	7·5	40·7	—
1*b*			1	100	74	49·0	4·5	46·5	—
1*c*			1	100	151	18·8	0·2	81·0	—
1*d*			1	100	166	0·7	0·0	99·3	—
1*e*			1	100	202	0·0	0·0	100·0	—
2*a* = 1*a*	I	Nickel on kieselguhr	1	100	20	51·8	7·5	40·7	—
2*b*			3	100	20	50·0	3·6	46·4	—
2*c*			5½	100	20	48·0	3·3	48·7	—
2*d*			7	100	20	46·7	1·1	52·2	—
3*a*	I	Nickel on kieselguhr	1	10	20	50·5	5·9	43·6	—
3*b*			1	10	80	48·5	3·0	48·5	—
3*c*			1	10	130	38·7	0·9	60·4	—
3*d*			1	10	205	20·8	0·6	78·6	—
4*a*	I	Molybdenum ρ on active carbon	1	100	20	51·1	11·2	37·7	—
4*b*			1	100	114	51·0	11·3	37·7	11
4*c*			1	100	139	51·5	9·2	39·3	—
4*d*			1	100	191	51·4	8·0	40·6	—
4*e*			1	100	250	51·2	5·5	43·3	—
4*f*			1	100	305	51·1	0·5	48·4	0
5*a*	II	Raney nickel	1	10	20	44·5	8·0	47·5	—
5*b*			1	10	50	43·3	5·2	51·5	—
5*c*			1	10	70	42·3	3·2	54·5	3
5*d*			1	10	95	42·4	2·1	55·5	—
5*e*			1	10	127	42·5	1·0	56·5	1
6*a*	II	Platforming catalyst	1	10	20	42·5	15·0	42·5	—
6*b*			1	10	55	43·5	15·5	41·0	—
6*c*			1	10	75	46·0	15·5	38·5	—
6*d*			1	10	92	44·0	16·0	40·0	—
6*e*			1	10	101	46·0	15·5	38·5	—
6*f*			1	10	120	47·5	12·5	40·0	—
6*g*			1	10	147	48·5	6·5	45·0	—
7*a*	II	Palladium on active carbon	1	10	20	46·6	12·4	41·0	—
7*b*			1	10	55	45·5	7·0	47·5	—
7*c*			1	10	79	44·2	1·8	54·0	1
7*d*			1	10	106	37·0	0·7	62·3	—
8*a*	II	Platinum on silica–alumina	1	10	20	46·8	9·3	43·9	9
8*b*			1	10	68	47·2	5·3	47·5	—
8*c*			1	10	111	47·5	2·0	50·5	—
8*d*			1	10	120	47·0	0·8	52·2	0
8*e*			1	10	155	40·6	0·5	58·9	—

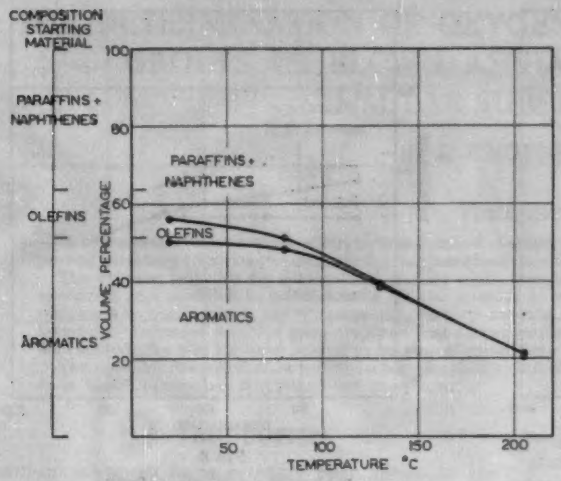

FIG 3

NICKEL ON KIESELGUHR CATALYST

10 atm initial hydrogen pressure
1 hr reaction time

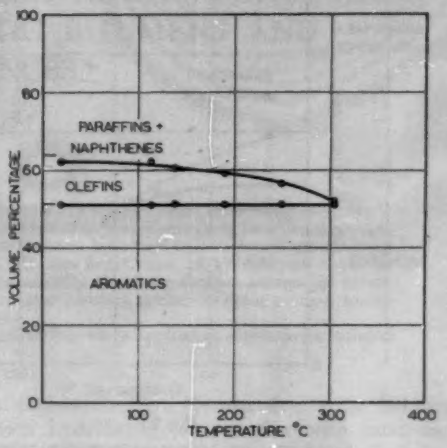

FIG 4

MOLYBDENUM ON ACTIVE CARBON CATALYST

100 atm initial hydrogen pressure
1 hr reaction time

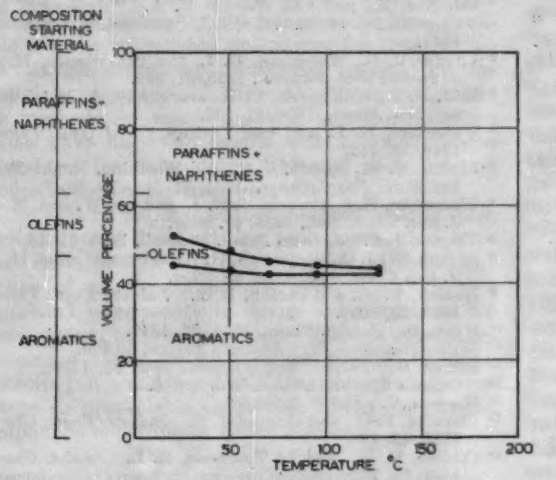

FIG 5

RANEY NICKEL CATALYST

10 atm initial hydrogen pressure
1 hr reaction time

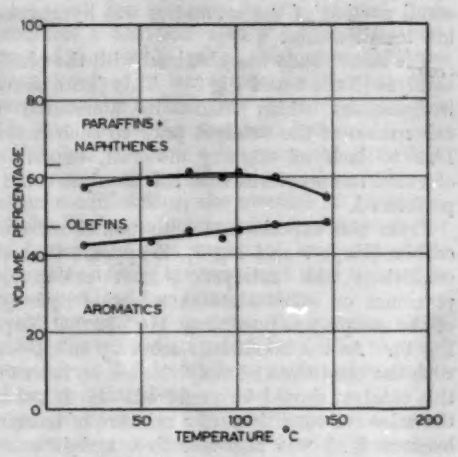

FIG 6

PLATFORMING CATALYST

10 atm initial hydrogen pressure
1 hr reaction time

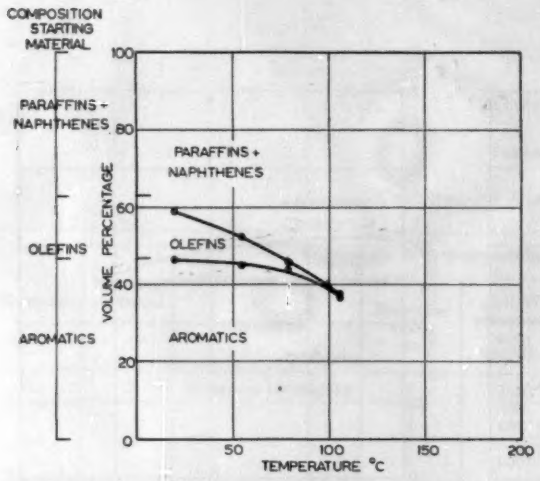

FIG 7

PALLADIUM ON ACTIVE CARBON CATALYST

10 atm initial hydrogen pressure
1 hr reaction time

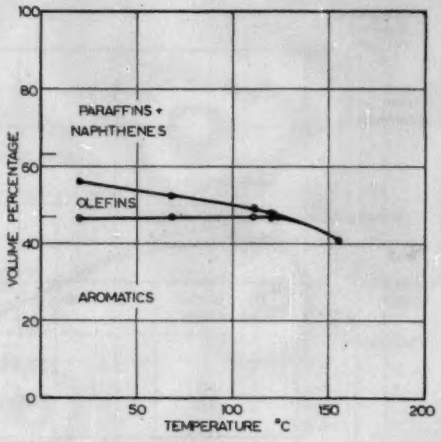

FIG 8

PLATINUM ON SILICA–ALUMINA

10 atm initial hydrogen pressure
1 hr reaction time

aromatics may occur at these rather severe conditions. Pre-saturation of the sample with nickel on kieselguhr at 150 C° and 100 atm initial pressure [7] cannot be recommended for these samples, in view of the experiments 1–3.

With Raney nickel (Expt 5 and Fig 5), selective hydrogenation of the sample was impossible, as a small portion of the aromatics was hydrogenated at low temperatures.

The same result was obtained with the platforming catalyst (Expt 6 and Fig 6). This figure shows some irregularities which might be attributed to the calcination of the catalyst prior to each experiment. Due to lack of starting material, experiments at elevated temperatures with this catalyst could not be performed.

From the experiments with palladium on active carbon (Expt 7 and Fig 7), it appears that at these conditions the catalyst is not selective. With platinum on silica–alumina selective hydrogenation of the sample was possible at 110°–120° C (Expt 8 and Fig 8). As the conditions are very mild, compared with the conditions of molybdenum on active carbon, this catalyst should be preferred. Hydrogenation at the selective conditions of a mixture of hexene-1 and benzene 1 : 1 was also selective, and it was shown that the mean molecular weight of the hexene–benzene mixture had not changed after the hydrogenation.

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References

[1] van Nes, K., and van Westen, H. A. "Aspects of the Constitution of Mineral Oils." Amsterdam: Elsevier, 1951.

[2] Vlugter, J. C., Waterman, H. I., and van Westen, H. A. *J. Instn Petrol. Technol.*, 1935, **21**, 661.

[3] Mair, B. J., Willingham, C. B., and Streiff, A. J. *J. Res. nat. Bur. Stand.*, 1938, **21**, 565.

[4] Waterman, H. I., and van Vlodrop, C. *J. Inst. Petrol.*, 1940, **26**, 452.

[5] Lipkin, M. R., Martin, C. C., and Worthing, R. C. *Proc. 3rd World Petrol. Congr.*, 1951, **VI**, Reprint 29.

[6] Waterman, H. I., Perquin, J. N. J., and van Westen, H. A. *J. Soc. Chem. Ind.*, 1928, **47**, 363T.

[7] Vlugter, J. C. *J. Instn Petrol. Technol.*, 1935, **21**, 36.

[8] de Kok, W. J. C., Waterman, H. I., and van Westen, H. A. *J. Soc. Chem. Ind.*, 1936, **55**, 225T.

[9] Ipatieff, V. N., and Corson, B. B. *Industr. Engng Chem.*, 1938, **30**, 1039.

[10] Miron, S. *Analyt. Chem.*, 1955, **27**, 1947.

[11] Wilbuschewitsch, M. Austrian Patent, 66,490.

[12] Raney, M. *Industr. Engng Chem.*, 1940, **32**, 1199.

[13] "Organic Synthesis," Coll. Vol. 3, 686.

[14] Haensel, V. U.S.P. 2,566,521.

[15] Ciapetta, F. G., and Hunter, J. B. *Industr. Engng Chem.*, 1953, **45**, 148.

[16] Criddle, D. W., and Le Tourneau, R. L. *Analyt. Chem.*, 1951, **23**, 1620.

[17] Schenk, P., Vervoorn, A. B. H., Waterman, H. I., and Weber, A. B. R. *J. Inst. Petrol.*, 1956, **42**, 205–16.

[18] "Standard Methods for Testing Petroleum and its Products." London: Institute of Petroleum, 1945.

THE DETERMINATION OF OXYGEN-CONTAINING FUNCTIONAL GROUPS IN BLOWN ASPHALTIC BITUMENS AND SIMILAR SUBSTANCES *

By J. KNOTNERUS †

SUMMARY

In connexion with an investigation on the chemical changes taking place in bitumen during blowing or ageing it proved necessary to revise the methods for the quantitative determination of oxygen-containing functional groups.

The existing methods for determining organic acids, saponifiable matter, hydroxyl and carbonyl groups were examined and modified in several cases for the purpose in view. It was found that group analysis could be restricted to these four types of compound, as they account for practically all of the oxygen present in blown bitumen. Infra-red analysis gave evidence that the saponifiable matter consists mainly of ester groups, whilst acid anhydrides and lactones proved to be almost completely absent.

The methods described show a sufficient repeatability, but their reliability when applied to asphaltenes isolated from blown bitumen is still somewhat uncertain.

INTRODUCTION

THOUGH advances have recently been made in the classification of the chemical compounds present in asphaltic bitumen,[17] little is known of the actual chemical constitution of this substance. The same applies to related materials such as oil sludges, oil deposits, etc. The changes in chemical constitution occurring during the oxidation of bitumen with air at a high temperature (the technical "blowing" process) are still also largely unknown.

For the purpose of an investigation on the bitumen blowing process, the results of which have been published elsewhere,[8] it was necessary to have available a series of reliable procedures for determining the oxygen-containing functional groups in the materials in question. Prior to this investigation, the methods for measuring acid and saponification values gave uncertain results with bitumen, whilst procedures for determining hydroxyl and carbonyl groups in such substances were unknown.

The present paper describes methods—partly new, partly adapted from existing procedures—that have been developed for the determination of these four groups of oxygen compounds in bitumen. It was considered unnecessary to devise determinations for ether, epoxy, or peroxy groups. Though substances containing these groups may be present in small amounts,‡ it could be shown that they do not constitute an appreciable proportion of the oxygenated compounds occurring in blown bitumen.

DETERMINATION OF HYDROXYL GROUPS: HYDROXYL VALUE

The methods for hydroxyl determination described in the literature are mainly based on the following principles: (1) reaction of ·OH with Grignard reagent (Zerewitinoff); (2) reaction with lithium aluminium hydride;[11] (3) reaction with acid anhydrides or acid halides.

For application to bitumen, methods based on the first two principles have the drawback of requiring perfectly anhydrous samples, whilst the reagents react with any group containing active hydrogen. $LiAlH_4$, moreover, reduces all kinds of groups containing carbonyl.

The third principle, particularly with acid anhydrides, appeared more promising. The method usually employed, that of Ogg *et al*,[18, 23] involves acetylation with acetic anhydride in pyridine. It cannot be used for bitumen in its original form (which requires a titration with a colour indicator), on account of the dark colour of the material and the low hydroxyl values to be measured. Furthermore, the water added for hydrolysing the excess of acetic anhydride precipitates the dissolved bitumen.

Potentiometric titration overcomes the first difficulty. As regards the second, the author followed, with certain modifications, the method of Dickinson and Nicholas,[5] who in determining hydroxyl in tar products hydrolysed the excess of acid anhydride with water after adding benzene, and then titrated in the vigorously stirred two-phase system.

It proved necessary to increase the reaction times considerably above that stated (4 hr). The required times varied from 2–6 hr for heavy oils and maltenes to 18–24 hr for isolated asphaltènes.§

The hydroxyl values obtained require a small correction on account of the organic acids present in the sample. However, only a part of these acids is determined under the conditions of the test; the method of correction adopted by Ogg *et al* (using a blank test without acetic anhydride) is therefore more correct than that employed by Dickinson and

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‡ The presence of other oxygen has been suspected,[16] but no method exists for its determination. Walther[16] has qualitatively demonstrated the occurrence of peroxides in bitumen oxidized at low temperatures.

§ Such times are not abnormal. The acetylation of cellulose derivatives, for instance, requires 24 hr.[13]

Nicholas, who determine the acid value correction in an altogether different medium.

A description of the procedure developed is given in Appendix I.

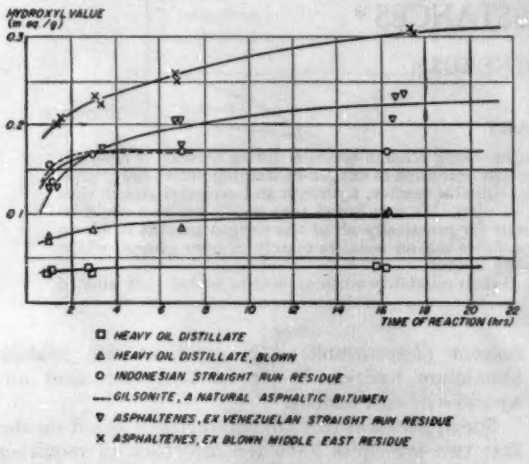

FIG 1

DETERMINATION OF OH GROUPS IN VARIOUS BITUMEN SAMPLES BY ACETYLATION

The graph shows the effect of the reaction time.

This method of hydroxyl determination was, generally speaking, found to be satisfactory. The values determined, or the reaction times required, may, however, be affected by steric hindrance. High molecular weight fatty acids, easily saponifiable esters of formic acid, and epoxy-groups may interfere with the determination.[10] Furthermore, NH_2, NH, and SH groups are determined by the procedure, so that various small inaccuracies are liable to be introduced. The last-named compounds, however, are only present in traces in most bitumens. Moreover, in the investigation to be undertaken the main concern was with the difference in ·OH value between starting material and blown product. For this purpose the determination was entirely reliable.

Fig 1 shows a plot of the hydroxyl values found for various materials against the reaction time. This graph demonstrates the satisfactory repeatability and the long reaction times required by asphaltenes isolated from bitumens.

DETERMINATION OF CARBONYL GROUPS: CARBONYL VALUE

None of the various methods described for determining :CO groups has so far been applied to bitumen. Most of the carbonyl determinations are based on reactions with hydroxylamine to form oximes, although these reactions do not always go to completion.[3] The hydroxylamine is employed either as the free base or as the hydrochloride, and the reaction is carried out in aqueous or alcoholic solution. The carbonyl content is calculated from either (1) the amount of amine consumed;[10,25] (2) the hydrochloric acid liberated;[13,22,23] (3) the water formed.[14]

With bitumen the first method gave unreliable results owing to side reactions, and the third required perfectly anhydrous samples. The second principle was therefore followed. Some modifications to existing methods as regards solvents and reaction time had, however, to be introduced, and the influence of heavy metal oxides on the decomposition of hydroxylamine had to be investigated.[3]

The procedure employed consisted of dissolving the sample in benzene, boiling it with a solution of hydroxylamine–HCl in *iso*propanol and a little water, cooling, adding water, and titrating the liberated HCl potentiometrically in the two-phase system with alkali.

The required boiling time was again found to be dependent on the presence or absence of high-molecular-weight substances. It can be taken to be 4 hr for maltenes and heavy oils and 18–24 hr for bitumens and asphaltenes. This fact is clearly demonstrated by Fig 2.

In the case of certain technical grades of bitumen and the asphaltenes obtained from them it may be that no final figure for the carbonyl value with increasing boiling time is observed. Two cases are shown in Fig 2 by dotted lines. It has been found that this effect is due to the decomposition of hydroxylamine by metallic oxides or salts, which are always present in residual oils. Nevertheless, the

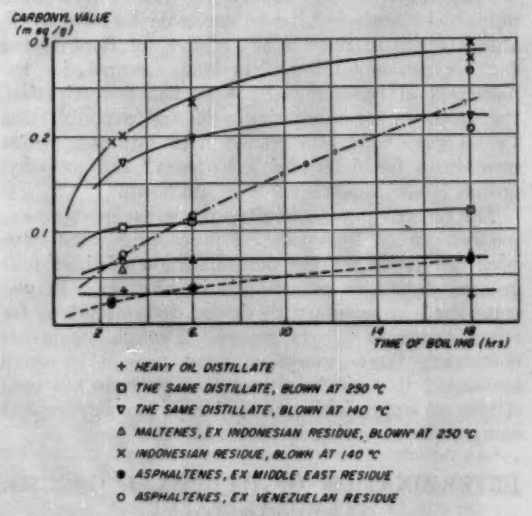

FIG 2

DETERMINATION OF C=O GROUPS IN VARIOUS OIL PRODUCTS AS A FUNCTION OF REACTION TIME

carbonyl value can be determined fairly accurately in such cases by extrapolating the straight part of the curve to the vertical axis and reading off the value at the point of intersection, as shown in Fig 3. The straight part of the curve is then assumed to represent

the decomposition of the hydroxylamine. The correctness of this procedure is demonstrated in the same figure, showing determinations on asphaltenes from distillates blown in glass and metal apparatus

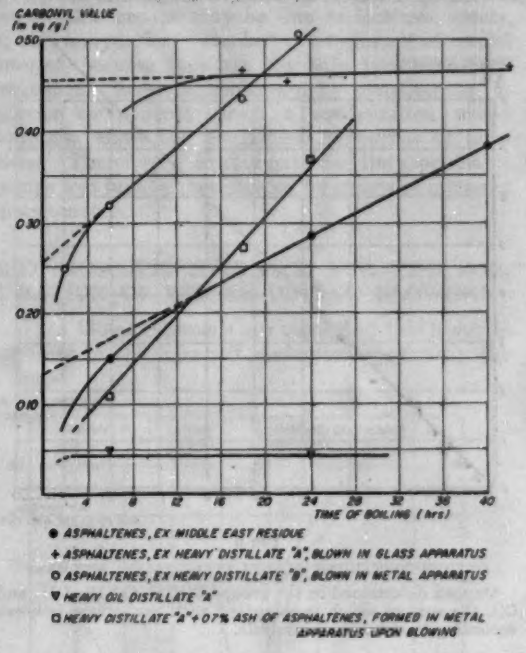

FIG 3

INFLUENCE OF METALLIC COMPOUNDS ON THE CARBONYL VALUE

and on a distillate with and without metal-containing ash. Iron oxide is probably the main source of trouble.

Other functional groups liable to be present have little or no influence on the determination. ·OH, ·COOH, and ·COOR do not interfere [24] under the conditions of the test. Acid anhydrides, epoxy-groups,[10] and thioketones [21] would interfere, but are absent, or present only in traces, in blown bitumen. Acid anhydrides could be determined by infra-red analysis and the result corrected accordingly.

The procedure developed for determining the carbonyl value is detailed in Appendix II.

DETERMINATION OF ESTER GROUPS: SAPONIFICATION VALUE

Ester groups are determined by the difference between the saponification value and the acid value.

A familiar method of determining the saponification value, which consists in dissolving the sample in alcohol–benzene, refluxing with alcoholic potash, and titrating with acid to the alkali blue end point, is not convenient for bitumen, owing to the dark colour of this material and the low solvent power of the medium for asphaltenes.

A much more satisfactory procedure is ASTM D939 [1] which uses benzene–*iso*propanol as solvent and potentiometric titration. The method could be slightly modified to make it suitable for bitumen. Here again, however, much longer boiling times than that prescribed (110–120 min) had to be adopted, namely, periods ranging from 2–6 hr for heavy oils and maltenes to 24 hr for asphaltenes and bitumens containing asphaltenes. With such long boiling times the exclusion of carbon dioxide is essential. The apparatus used (a Babcock flask and tube) was therefore fitted with a CO_2 trap containing soda–asbestos (ascarite).

After saponification, the mixture was acidified with an excess of *iso*propanolic HCl and titrated back potentiometrically with *iso*propanolic alkali. The results, after subtraction of acid value, were in reasonable agreement with the ester value obtained by infra-red analysis.

Fig 4 shows some plots of saponification value against boiling time.

With some samples of asphaltenes the reproducibility is not very good and deviations up to ± 20 per cent occur.

Appendix III describes the method used.

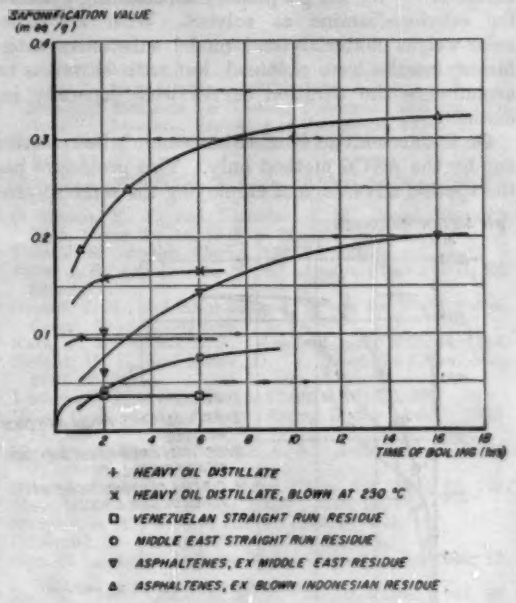

FIG 4

SAPONIFICATION VALUE AS A FUNCTION OF THE REACTION TIME FOR VARIOUS PRODUCTS

DETERMINATION OF CARBOXYL GROUPS: ACID VALUE

For the determination of carboxylic acids in blown bitumens and similar materials, a colour indicator method is again unsatisfactory owing to the dark colour of the solutions. A method of this type much

used in the oil industry (IP 100/53 T),[2] furthermore, cannot generally be employed because the medium, benzene–ethanol, has an insufficient solvent power for asphaltenes.

Several methods involving potentiometric titrations in non-aqueous media are found in the literature, for instance Ruehle.[20] An attractive procedure is ASTM D664,[1] consisting of a potentiometric titration with *iso*propanolic KOH, using glass and calomel electrodes, in a solution of benzene–*iso*propanol.

In studying the bitumen blowing process it would have been desirable to possess a method for estimating not only carboxylic acids, but also very weak acids such as phenols. Methods for this purpose have been described by Moss, Elliott, and Hall [15] and other investigators; [4, 6, 7, 19] they are founded on the use of an amine as basic solvent. Though such a method has been employed successfully for estimating phenols in coal hydrogenation products,[9] it was found that the procedures cannot conveniently be applied to asphaltic bitumen for practical reasons, namely, on account of the electrode systems, solvents, or titrants used; furthermore, the exact nature of the compounds titrated is somewhat uncertain.

An attempt was made to adapt two of the latter methods [4, 15] for the purpose by substituting pyridine for ethylenediamine as solvent. With low-molecular-weight materials and model substances satisfactory results were obtained, but with bitumens or asphaltenes the titration curves were generally indistinct.

On this account acid values have mainly been carried out by the ASTM method only. This procedure has the specific advantage of employing the same solvent

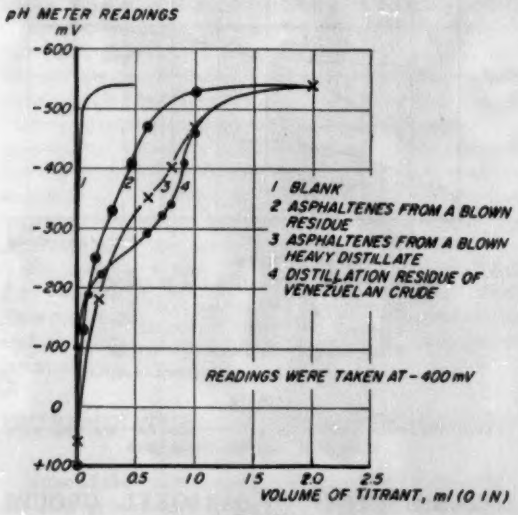

FIG 5

ACID VALUE DETERMINATION OF BITUMINOUS PRODUCTS

mixture as the saponification value method. Fig 5 shows a few examples of titration curves found with various products.

RESULTS OBTAINED WITH THE DESCRIBED METHODS OF GROUP ANALYSIS

The suitability of the methods described is demonstrated by Table I, in which some results are given

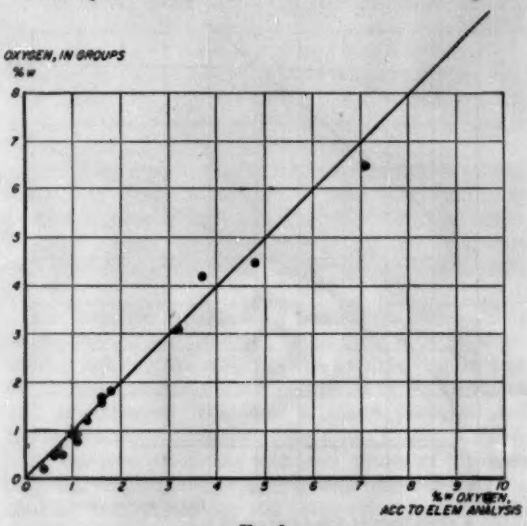

FIG 6

OXYGEN-CONTAINING GROUPS IN ASPHALTIC BITUMENS

Oxygen determined in the groups COOH, COOR, OH, and CO, the sum of which is compared with the oxygen content according to elementary analysis.

TABLE I

Some Results of Group Analysis on Bitumens and Allied Materials

Material to be analysed	% wt oxygen in groups					% wt of oxygen according to elementary analysis
	COOH	COOR	OH	CO	Total	
A. Distillate Oil						
Heavy distillate oil	0·00	0·1	0·03	0·07	0·2	0·4
The same oil, blown at 150° C	0·45	1·9	0·3	0·45	3·1	3·2
The same oil, blown at 250° C	0·09	0·9	0·24	0·35	1·6	1·6
Maltenes, ex oil, blown at 150° C	0·10	0·46	0·11	0·14	0·8	1·1
Maltenes, ex oil, blown at 250° C	0·03	0·65	0·10	0·40	1·2	1·3
Asphaltenes, ex oil, blown at 150° C	1·15	4·1	0·34	0·91	6·5	7·1
Asphaltenes, ex oil, blown at 250° C	0·26	2·95	0·21	0·75	4·2	3·7
B. Residual Oil						
Residual oil	0·00	0·15	0·10	0·05	0·3	0·5
Blown residual oil	0·01	0·5	0·20	0·24	0·95	1·0
Residual asphaltic bitumen	0·01	0·1	0·31	0·10	0·5	0·6
Asphaltenes, ex residual bitumen	0·1	0·1	0·5	0·3	1·0	ca 1·0
Asphaltenes, ex blown residual bitumen	0·25	1·15	0·3	0·15	1·85	1·8

for both original and blown materials. It appears from the data that with the four functional groups mentioned practically all of the oxygen bound in the bitumen by blowing can be accounted for. Consequently the formation of ethers or other oxygen-containing groups during blowing is negligible. The

correctness of these conclusions is also clearly demonstrated by Fig 6.

It will be seen from Table I that in many cases the COOR configuration is the most abundant of the oxygen-containing groups. This large content of saponifiable groups may be due to lactones, esters, or acid anhydrides. The last two types are of special interest, because they are the only possibilities for condensing lower-molecular-weight constituents to heavier components; such a condensation would doubtless affect the mechanical properties of bitumens. Therefore, the exact nature of the saponifiable groups was further investigated by means of infra-red spectrometry.

SPECTROSCOPIC EVIDENCE FOR THE FORMATION OF ESTERS DURING BLOWING

When blown bitumens are saponified this becomes apparent in the infra-red absorption spectrum; the

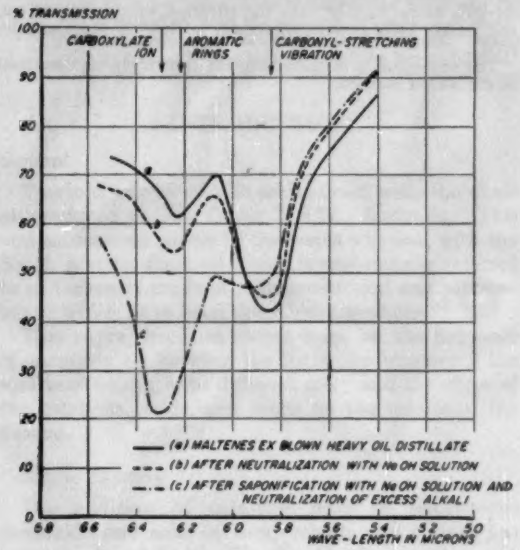

FIG 7

MODIFICATION OF THE INFRA-RED SPECTRUM OF MALTENES EX BLOWN HEAVY OIL DISTILLATE IN THE C=O STRETCHING REGION BY TREATMENT WITH SODIUM HYDROXIDE

strong carbonyl absorption at 5·8 μ largely disappears, while a new band is formed at 6·3 μ, which is to be attributed to the CO vibration of carboxylic acid salts (Fig 7). The remainder of the absorption band at 5·8 μ originates from ketones and aldehydes. This evidence confirms the presence of saponifiable material, but does not provide more detailed information.

Acid anhydride groups always have a characteristic doublet in the absorption spectrum; besides a band at 5·6–5·8 μ there is one at a shorter wavelength, 5·4–5·6 μ. The almost complete absence of such a doublet in the absorption spectra of the oxidized products indicates, therefore, the absence of acid anhydrides, though traces of such compounds were indicated in a few cases.

Infra-red analysis also shows that β and γ lactones are not formed during blowing. The presence of these groups would be indicated by a shift of the carbonyl absorption towards a shorter wavelength as compared with the normal ester-carbonyl absorption.

The possibility exists that the strong carbonyl absorption is due to free acids of such a high molecular weight or such a structure that they are not determined by the acid value method. The infra-red carbonyl absorption of any acid is, however, sensitive to the nature of some solvents normally used, owing to the formation of hydrogen bridges. As no such effect could be observed, the above possibility can be ruled out, and the conclusion must be that the saponifiable matter is constituted by ester groups.

ACKNOWLEDGMENTS

The author wishes to thank all those who have assisted him in this work, and the management of the Koninklijke/Shell-Laboratorium, Amsterdam, for permission to publish this paper.

References

1 "ASTM Standards on Petroleum Products and Lubricants." Philadelphia: ASTM, 1956.
2 "Standard Methods for Testing Petroleum and its Products." London: Institute of Petroleum, 1956.
3 Bryant, W. M. D., and Smith, D. M. *J. Amer. Chem. Soc.*, 1935, **57**, 57.
4 Deal, V. Z., and Wyld, G. E. A. *Analyt. Chem.*, 1955, **27**, 47.
5 Dickinson, E. J., and Nicholas, J. H. Road Research Tech. Paper No. 16, 1949, p. 26.
6 Fritz, J. S. *Analyt. Chem.*, 1952, **24**, 674.
7 Fritz, J. S., and Lisicki, N. M. *Analyt. Chem.*, 1951, **23**, 589.
8 Goppel, J. M., and Knotnerus, J. *Proc. 4th World Petrol. Congr.*, 1955, **3**, 399–415.
9 Katz, M., and Glenn, R. A. *Analyt. Chem.*, 1952, **24**, 1157.
10 Knight, H. B., and Swern, D. *J. Amer. Oil Chem. Soc.*, 1949, **26**, 366.
11 Lintner, C. J., *et al.* *Analyt. Chem.*, 1950, **22**, 534.
12 Malm, C. J., *et al.* *Industr. Engng Chem.* (*Anal.*), 1942, **14**, 935.
13 Metcalfe, L. D., and Schmitz, A. A. *Analyt. Chem.*, 1955, **27**, 138.
14 Mitchell, J., Jr., *et al.* *J. Amer. Chem. Soc.*, 1941, **63**, 573.
15 Moss, M. L., *et al.* *Analyt. Chem.*, 1948, **20**, 784.
16 Murphy, B. A. *J. Inst. Petrol.*, 1945, **31**, 475.
17 O'Donnel, G. *Analyt. Chem.*, 1951, **23**, 894.
18 Ogg, C. L., *et al.* *Industr. Engng Chem.* (*Anal.*), 1945, **17**, 394.
19 Radell, J., and Donahue, E. T. *Analyt. Chem.*, 1954, **26**, 590.
20 Ruehle, A. E. *Industr. Engng Chem.* (*Anal.*), 1938, **10**, 130.
21 Schönberg, A. "Thioketone, Thioacetale und Aethylensulfide," Stuttgart, 1933.
22 Shriner, R. L. "Quantitative analysis of organic compounds," p. 48. Bloomington, Indiana, 1947.
23 Siggia, S. "Quantitative organic analysis via functional groups," New York, London, 1954.
24 Smith, D. M., and Mitchell, J., Jr. *Analyt. Chem.*, 1950, **22**, 750.
25 Trozzolo, A. M., and Lieber, E. *Analyt. Chem.*, 1950, **22**, 764.
26 Walther, H. *Mitt. Dachpappenind.*, 1938, 135.

APPENDIX I

Determination of the Hydroxyl Value

Weigh out 0·5–2 g of the bitumen or similar material into a Babcock flask fitted with an upright tube by ground joint and dissolve it in 10 ml of pyridine. Add exactly 2 ml of a mixture of 1 vol of acetic anhydride and 9 vol of pyridine. Connect the tube as reflux condenser and boil for the proper time on a hot-plate. Add 10 ml of benzene and 20 ml of water to the boiling mixture and shake thoroughly. Cool to room temperature and pour the mixture into a 100-ml beaker; rinse the flask three times with 2½ ml of water and 2½ ml of benzene. Titrate the total liquid potentiometrically, while stirring, with approximately 0·1N aqueous NaOH to $pH = 9$, using glass and calomel electrodes.

Titrate a second quantity of the sample with NaOH after treating with the same solvents, but without acetic anhydride. Thirdly, carry out a blank titration, with acetic anhydride but without sample. If a, b, and c ml of NaOH (normality t) were required for these three titrations, respectively, and the weights of sample in the first two were m and n g, the hydroxyl value is

$$\frac{(c-a)\times t}{m}+\frac{b\times t}{n}\quad (m\ eq/g).$$

APPENDIX II

Determination of the Carbonyl Value

In a Babcock flask fitted with a tube dissolve 0·5–2 g of the material in 10 ml of benzene. Add 10 ml of *iso*propanol and 2 ml of a reagent made by dissolving 10 g of hydroxylamine hydrochloride in a mixture of 20 g of water and 70 g of *iso*propanol. After boiling under reflux for the indicated time, cool to room temperature, add 20 ml of water, and pour into a beaker. Rinse the flask three times with 2½ ml of benzene and 2½ ml of water. Titrate potentiometrically, while stirring, with approximately 0·1N aqueous NaOH to $pH = 3·5$, using glass and calomel electrodes.

Carry out a blank determination without sample.

If a and b ml of alkali (normality t) were required for the two titrations respectively, and the weight of sample was m g, the carbonyl value is given by

$$\frac{(a-b)t}{m}\quad (m\ eq/g)$$

The titrations may show deviations of 0·1 ml of liquid. Since the volumes involved are seldom larger than 1 to 2 ml, this corresponds to a deviation of 5 to 10 per cent.

APPENDIX III

Determination of the Saponification Value

ASTM D939 is used in the following modified form.

Dissolve 0·5–2 g of bitumen in 30 ml of benzene in a Babcock flask fitted with a tube provided at its end with an ascarite CO_2 trap. Add 20 ml of 0·1N *iso*propanolic KOH, and boil under reflux for the time required. After cooling acidify with 25 ml of 0·1N *iso*propanolic HCl, pour the liquid into a beaker, rinse out the flask with the ASTM titration solvent, dilute further with the titration solvent to 125 ml, and titrate back potentiometrically with 0·1N *iso*propanolic KOH.

The procedure is in other respects carried out as described in the ASTM method.

STUDIES IN SHALE OIL

PART VIII. FLUXING THE BLOWN BITUMEN*

By GEO. E. MAPSTONE† (Fellow) and H. KARIUS†

SUMMARY

Of several catalysts examined for their influence on the blowing of torbanite, bitumen ferric chloride appeared to be the best. The use of 0·7 per cent of this catalyst approximately halved the blowing time required and effected a slight improvement in the softening point–penetration relationship. This latter improvement could, however, be effected also by the addition of ferric chloride or of hydrochloric acid to the non-catalytically blown bitumen, an effect which appears to be related to the acid polymerization of the pyrroles present in the bitumen. However, a similar effect on the softening point and penetration was obtained by adding hydrochloric acid or ferric chloride to Aramco or Venezuelan bitumen.

The use of aliphatic fluxing oils, such as Fischer–Tropsch or Penn base oils, increased the softening point–penetration relationship but at the expense of the ductility of the product. Aromatic oils, such as pitch coking oil, caused a large decrease in the softening point for a small increase in the penetration. Acid fatty oils available commercially varied in their action, but always gave improved softening point–penetration relationships over and above that of torbanite gas oil. This was accompanied by some initial loss of desired physical properties of the bitumen, the blend becoming first brittle, then cheesy, and finally, ductile again with increasing addition of the oil. The presence of ferric chloride or hydrochloric acid improved the response of the bitumen to these oils so that, in many cases, both the softening point and penetration increased with the addition. Blending various oils with and without the addition of soaps or of alkali to form soaps suggested that the neutralization of the free fatty acids played a part on this improvement. Also polymerization of the pyrroles by the acid, either added as such or formed by the hydrolysis of the ferric chloride, appeared to play a significant role in producing this effect, which was obtained only in torbanite bitumen and not in Aramco or Venezuelan bitumen.

INTRODUCTION

General

Previous papers of this series dealt with the shale oil produced at Glen Davis, N.S.W., Australia. This and subsequent papers of the series will deal with the South African shale oil which is customarily referred to as torbanite crude oil, the production and processing of which have been described elsewhere.[1–3]

This paper describes recent work on the influence of catalysts on blowing the torbanite bitumen; the results of fluxing with different oils; and the effect of the catalysts, acids, and soaps on the results of the fluxing.

Catalytic Blowing

The addition of catalysts such as phosphorus pentoxide and salts of iron, cobalt, and copper has been employed to modify the blowing reactions to improve the temperature susceptibility of bitumens after blowing.[4] As the effect of catalysts on the blowing of torbanite bitumen was unknown, several were examined under constant blowing conditions in the laboratory.

Effect of Acid and Ferric Chloride

The addition of hydrochloric acid and ferric chloride was found to have a significant effect on the properties of the bitumen and on its behaviour when fluxed with some fatty oils. This effect was considered as possibly due to the acid polymerization of the pyrroles which are well known constituents of shale oils, and examination of a sample of acid-treated bitumen [5] confirmed the presence of pyrrole polymers. These polymers are unstable to heat and decompose with the liberation of ammonia.[6,7]

Fluxing

The rheological properties of bitumens can be explained by assuming that some bitumens are a sol while others are a gel. If the micelles, which are a complex of the asphaltenes with the high molecular aromatic components of the maltenes, are well peptized, the bitumen behaves like a sol. If, on the other hand, they are partially flocculated, they can give rise to a more or less rigid structure and the bitumen behaves like a gel. This condition depends upon the concentration and chemical character of the two phases.

According to Pfeiffer and Saal,[8] complete peptization of the micelle is possible if the system contains enough aromatic constituents, in relation to the concentration of the asphaltenes, to saturate the adsorption forces of the asphaltenes. If, however, the aromatic content is insufficient in this respect, mutual attraction between the micelles occurs, leading to the formation of a gel structure or even to precipitation of the asphaltenes.

Pfeiffer [9,10] has presented experimental evidence that fluxing a bitumen with a suitable non-aromatic oil can increase both the penetration and the softening point. This would indicate that not only is the asphaltene–aromatic ratio important, but also the proportion of aromatics in the maltenes. This increase in the gel structure can be considered as the initial precipitation of the asphaltenes by the diluent

* MS received 27 February 1956.

† South African Torbanite Mining and Refining Co. Ltd.

in the same manner that they may be precipitated by any aliphatic solvent such as *n*-heptane. Consequently, it can be predicted that the addition of too much of an aliphatic oil could lead to the extensive coagulation and precipitation of the asphaltenes with the complete loss of the bitumen properties.

It was with these factors in mind that the initial work was carried out on the fluxing of torbanite bitumen with a number of different oils.

Subsequent work was carried out with the object of elucidating, as far as possible, the principles involved in the fluxing and blending so that fluxed bitumens of desired properties could be prepared at will.

EXPERIMENTAL

In all cases the softening points were determined by the Ring and Ball Method (IP 58/55) and penetrations were carried out at 77° F (IP 49/53). For low penetrations fractional values obtained by averaging at least four readings are sometimes reported.

Blowing

Batches of 2–2½ kg of bitumen of 360+ penetration were heated to 400°–500° F in a container 10 cm diameter and 43 cm deep and fitted with a bottom sampling valve, a lid, and gas off-take to a condenser. When the bitumen reached the desired temperature (in this work 470° F) air was passed through at the rate of 4 litres/kg/min. Samples were drawn periodically and the softening point and penetration determined.

Various amounts of catalysts were added as required to the molten bitumen before blowing. In this work the blowing conditions were kept constant and no attempt was made to explore their effect on the results, the main requirement being the evaluation of the catalysts.

The softening point–penetration relationships obtained were compared graphically with the same bitumen blown without catalysts; phosphorous pentoxide, vanadium pentoxide, ammonium vanadate, and ferric and aluminium chlorides in Fig 1.

Effect of Addition of Hydrochloric Acid and Ferric Chloride to Bitumen

The desired amount of ferric chloride was added to 200 g of the molten bitumen stirred with a fast mechanical stirrer for 10–15 minutes at 320°–370° F. The hydrochloric acid addition to the bitumen was normally made at 40°–60° F above the softening point and the stirring continued until all the free water had evaporated. At higher temperatures serious foaming occurred, but could be overcome by controlling the temperature.

A sample of untreated 200 penetration torbanite bitumen was heated to 260° C (500° F). There was a gradual and slight evolution of vapours. A test paper inserted into the vapours showed a pH between 7 and 8. Purging the vapours from the flask into acid failed to reveal any trace of ammonia.

A sample of bitumen that had been treated with acid [5] and neutralized with a slight excess of lime was then heated carefully. At 230° C (446° F) there was a fairly rapid evolution of yellow fumes, and a moistened test paper held just above them indicated a pH of 11. Ammonia could be smelt readily and was also detected chemically, thus confirming the presence of pyrrole polymers in the acid-treated bitumen.

Fluxing

A weighed amount of the bitumen (approximately 300 g) was melted and a weighed amount of the fluxing oil stirred in mechanically until the blend appeared uniform. This usually required about 15 minutes. The mixing temperature was usually about 320°–340° F unless otherwise specified.

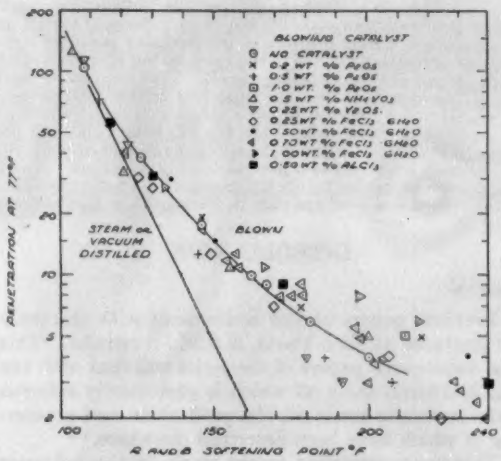

FIG 1

EFFECT OF CATALYSTS ON BLOWING

TABLE I

Effect of Hydrochloric Acid and Ferric Chloride on Softening Point and Penetration of Bitumens

Additive	Bitumen	Softening point (° F)		Penetration	
		Before	After	Before	After
0·8% $FeCl_3.6H_2O$	Torbanite	154	161	13	12
1·8% conc HCl	Torbanite	159	196	11	8
1·8% conc HCl	Torbanite	180	204	5	4
0·8% $FeCl_3.6H_2O$	Torbanite	181	194	5	6
0·8% $FeCl_3.6H_2O$	Torbanite	185	197	4	6
0·8% $FeCl_3.6H_2O$	Torbanite	193	206	3	6
0·9% $FeCl_3.6H_2O$	Torbanite	194	202	3	5
1·6% conc HCl	Torbanite	194	205	3	3
0·7% $FeCl_3.6H_2O$	Torbanite	224	244	2	2
1·0% $FeCl_3.6H_2O$	Torbanite	262	278	1½	1½
0·7% $FeCl_3.6H_2O$	Aramco	216	232	10	9
0·7% $FeCl_3.6H_2O$	Venezuelan	252	278	10	10
1·6% conc HCl	Venezuelan	252	257	10	8

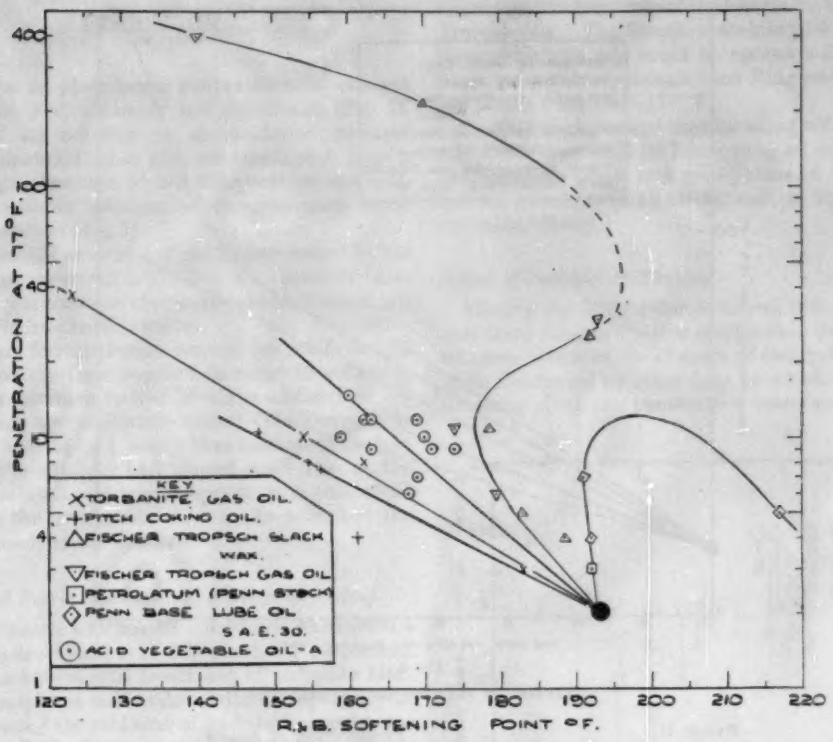

FIG 2

EFFECT OF FLUXING ON BITUMEN PROPERTIES

TABLE II

Properties of Fluxing Oils Used in Preliminary Tests

Samples	Fischer-Tropsch slack wax	Fischer-Tropsch gas oil	Torbanite gas oil	Pitch coking oil	Petrolatum (Penn Base)	Penn Base lub oil	Acid vegetable oil A
Sp. gr. at 60° F	0·774	0·788	0·938	1·202	0·869	0·890	0·930 at 130° F
Distillation, ° C:							
I.B.P.	280	269	242	367	286	348	256 cracking
5%	—	277	267	268	338	372	
10%	300	280	276	373	354	380	
20%	316	283	285	394	367	386	
30%	322	288	303	413	374	389·5	
40%	329	291	316	438	381	393	
50%	336	293	332	467*	382	396	
60%	342	298	350	Cut	385	Cut	
70%	350	302	363		393		
80%	362	307	390		400		
90%	380	316	Cut		Cut		
95%	—	337					310° C 147
F.B.P.	388	332					
% recovered	96	97					
% residue	4	3					
					(SAE 30)		

* Estimated.

The properties of the oils used in the preliminary fluxing tests are given in Table II. The results of the preliminary tests are listed in Table III and are analysed in Figs 2, 3, and 4.

The fatty oils used in the fluxing work are listed in Table IV, together with such properties as were determined.

The subsequent work presented in Figs 5–12 was carried out in the same way.

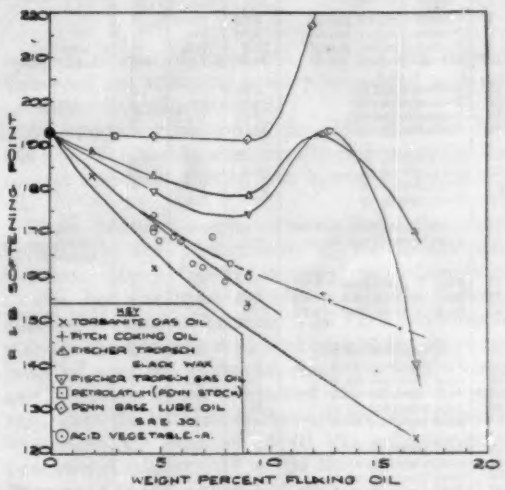

FIG 3

EFFECT OF FLUXING ON SOFTENING POINT

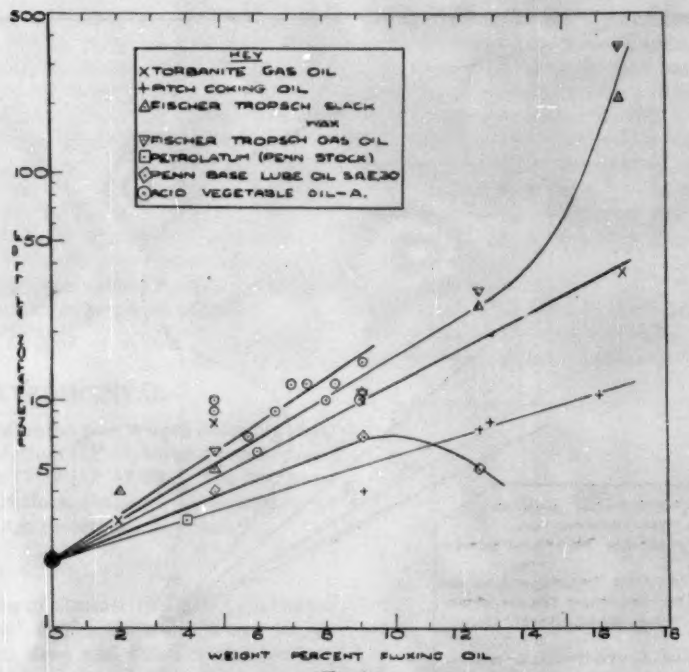
KEY
X TORBANITE GAS OIL
+ PITCH COKING OIL
△ FISCHER TROPSCH SLACK WAX
▽ FISCHER TROPSCH GAS OIL
⊡ PETROLATUM (PENN STOCK)
◇ PENN BASE LUBE OIL SAE 30
⊙ ACID VEGETABLE OIL-A.
PENETRATION AT 77° F
WEIGHT PERCENT FLUXING OIL

FIG 4

EFFECT OF FLUXING ON PENETRATION

TABLE III

Results of Preliminary Bitumen Blending Tests

Blend No.	Oil added	Wt of oil	R. & B. S.P., °F	Pen at 77° F	Remarks
1	Nil	Nil	193	2	
2	Fischer-Tropsch slack wax	1·96	188·5	4	
3	Fischer-Tropsch slack wax	4·76	183	5	
4	Fischer-Tropsch slack wax	9·09	178·5	11	
5	Fischer-Tropsch slack wax	12·5	192	26	Very cheesy
6	Fischer-Tropsch slack wax	16·67	170	212	Extremely cheesy
7	Fischer-Tropsch gas oil	4·76	179·5	6	
8	Fischer-Tropsch gas oil	9·09	174	11	
9	Fischer-Tropsch gas oil	12·8	193	30	Cheesy
10	Fischer-Tropsch gas oil	16·67	c. 140	340+	Useless—pasty
11	Torbanite gas oil	1·96	183	3	
12	Torbanite gas oil	4·76	162	8	
13	Torbanite gas oil	9·09	154	10	
14	Torbanite gas oil	16·67	123	37	
15	Pitch coking oil	9·09	161	4	
16	Pitch coking oil	12·5	156	7½	
17	Pitch coking oil	12·8	154·5	8	
18	Pitch coking oil	16·0	148	10½	
19	Petrolatum (Penn Base)	3·96	192	3	
20	Petrolatum (Penn Base)	12·5	—	—	Asphaltenes coagulated
21	SAE 20 Penn Base lub oil	4·76	192	4	
22	SAE 30 Penn Base lub oil	9·09	191	7	
23	SAE 30 Penn Base lub oil	12·5	217	5	Slight indication of cheesiness
24	Acid vegetable oil A	5·0	192	4	
25	Acid vegetable oil A	6·0	168	6	
26	Acid vegetable oil A	7·0	162	12	
27	Acid vegetable oil A	8·0	159	10	
28	Acid vegetable oil A	9·0	153	10	
29	Acid vegetable oil A	4·77	171	9	
30	Acid vegetable oil A	4·77	170	10	
31	Acid vegetable oil A	4·77	174	9	
32	Acid vegetable oil A	5·66	169	7	
33	Acid vegetable oil A	6·54	163	9	
34	Acid vegetable oil A	7·41	169	12	
35	Acid vegetable oil A	8·26	163	12	
36	Acid vegetable oil A	9·09	160	15	

Preparation of Soaps

The potassium soap used was prepared by saponification of oil F (crude pilchard oil). The soap was finally dried at 120° C for several hours before use.

The other soaps were prepared by precipitation of an aqueous solution of the potassium soap. Assuming that the average molecular weight of the fatty acids was 300, the calcium soap was very nearly neutral (found 6·4 per cent calcium, required 6·2 per cent); the aluminium soap was a mixture of the monobasic and normal soaps (found 3·5 per cent aluminium, required for normal soap 2·9 per cent). The ferric soap was the dibasic soap.

The aluminium stearate used was B.D.H. reagent grade. It contained 10·01 per cent ash, corresponding closely to the dibasic soap.

TABLE IV

Fatty Oils Used in Bitumen Blends

Oil	Description	Appearance at room temp	Acid value	% Free acid	Saponification value	Iodine No. (Hanus)
A	Congo cotton acid oil No. 1	Solid	115	62	253	n.d.
B	Congo cotton acid oil No. 2 *	Solid	160	80·5	201	n.d.
C	Nola acid oil No. 1	Liquid	67	34	197	108
D	Nola acid oil No. 2	Liquid	44	22	195	110
E	Maripol 21	Liquid	4·7	—	—	—
F	Walvis Bay crude pilchard oil	Liquid	3·1	—	—	—

* Contained approximately 1¼% iron (as Fe) in the form of ferrous soaps.

DISCUSSION

Blowing

The action of phosphorus pentoxide as a catalyst was variable and probably not significant (Fig 1). Because of its activity as an oxidation catalyst vanadium pentoxide was also examined and gave a possibly slight decrease in the temperature susceptibility of the blown bitumen, while ammonium vanadate had no effect (Fig 1).

Ferric chloride showed a slight improvement to the temperature susceptibility (Fig 1), possibly also paralleled by anhydrous aluminium chloride which is a stronger Friedel–Crafts catalyst.

Apart from ferric chloride, none of the catalysts had any effect on the time required to raise the softening point of the bitumen to 200° F. The addition of the ferric chloride approximately halved the blowing time (from 8 ± 1 to $3\frac{1}{2} \pm \frac{1}{2}$ hour), thus indicating that, in this case, the catalyst had played some role in the blowing reactions. It would appear that this effect was due to the iron rather than to the acid, but the reactions involved are obscure.

Additions of Ferric Chloride and Hydrochloric Acid

When bitumen was heated with ferric chloride the odour of hydrochloric acid was distinctly noticeable. Since it was known that treatment of torbanite bitumen with sulphuric acid reduced its susceptibility to oxygen attack,[5] the addition of hydrochloric acid was examined. Both ferric chloride and hydrochloric acid increased the softening points appreciably; their effect on the penetration varied from a small decrease to a small increase (Table I).

The addition of acid polymerized the pyrroles present in the torbanite bitumen, and this reaction, by converting an aromatic maltene constituent to an insoluble or possibly asphaltenic product could explain the change in properties. It is interesting that a similar effect was produced by these additives in blown Aramco and Venezuelan bitumens (Table I).

The effect of these additives will be referred to again later in the discussion on the fluxing work.

Fluxing

The results of the preliminary work (Table I, Figs 2, 3, 4) amply bore out the contention that the addition of an aliphatic fluxing oil could improve the temperature susceptibility of the bitumen. As was to be expected, the highly aromatic pitch coking oil increased the temperature susceptibility more than did torbanite gas oil. The effect of the Fischer–Tropsch oils on first decreasing and then increasing the softening point before softening them extensively was more or less to be expected, as once the maximum gelation of the asphaltenes had been obtained, further addition of the oil would give further softening or even precipitation of the asphaltenes. This precipitation was, in fact, obtained with the petrolatum (Table III), and was no doubt the factor responsible for the brittleness or cheesiness of the blends with the Fischer–Tropsch oils. The blends containing 16·7 per cent of these paraffinic oils could be spread with a knife at room temperature, though then Ring and Ball softening points were 140°–170° F.

Further work showed that blending with petrolatum and Penn base SAE 60 lubricating oil increased both the softening point and penetration of the bitumen, but the blends were all brittle and, at higher additive contents, cheesy.

Effect of Catalyst on Fluxing

Fluxing the ferric chloride–blown bitumen with the acid fatty oils gave better results than did fluxing the bitumen blown in the absence of catalysts. This was again illustrated by other data, in which case both the softening point and penetration were increased by the addition of one of these oils, whereas the same oil decreased the softening point when added to a non-catalytically blown bitumen.

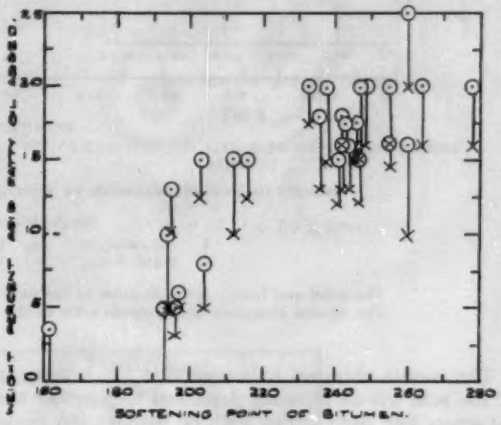

Fig 5

○ Ductile blend × Cheesy blend

An interesting feature of the addition of the fatty oils was that blends were usually rather brittle, then cheesy, and then ductile with increasing amounts of oil.

These textures were assessed from the visible appearance and performance of the blends when handled. Many factors appeared to influence the results, but the most significant was the softening point of the original bitumen. In Fig 5 the softening point of the bitumen is plotted against the amount of fatty oil over the transition range between a cheesy and a ductile blend. Linseed oil, either blown or raw, gave ductile blends throughout the range, but had much the same effect on the softening-point–penetration relationship as did the torbanite gas oil. Because of the relatively high costs of the linseed oils, no further work was carried out to find the cause of the difference.

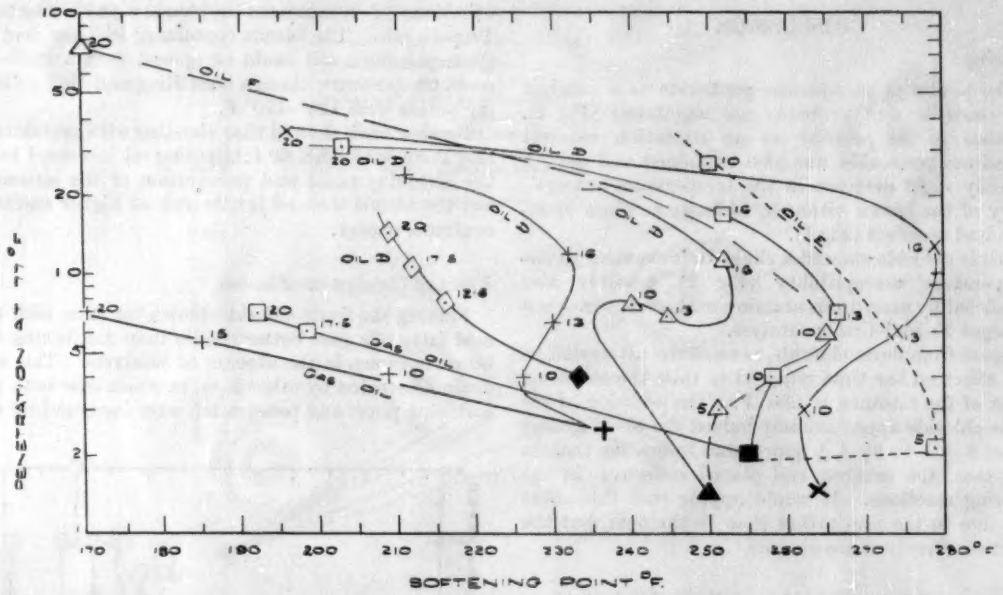

FIG 6

EFFECT OF FERRIC CHLORIDE IN BITUMEN ON SOFTENING POINT AND PENETRATION

Blown Bitumen Preparation

◈ No catalyst ◬ 0·3% $FeCl_3$ × 0·5% $FeCl_3$
+ 0·3% $FeCl_3$ ⊡ 0·5% $FeCl_3$ ⊙ 0·7% $FeCl_3$

The solid and heavy symbols refer to the unfluxed bitumen.
The figures alongside the symbols refer to the wt % of fluxing oil in the bitumen.

The results obtained indicated that the behaviour of the acid oils on blending depended on whether the bitumens had been blown with or without the ferric chloride catalyst. That this effect did exist was proved by the data given in Fig 6 on the fluxing of four ferric chloride–blown bitumens and one straight-blown bitumen with different amounts of the same acid oil. The extent of this effect was shown to be a function of the ferric chloride content of the bitumen (Fig 6).

The presence of the free fatty acids appeared to decrease the effectiveness of the oils in improving the softening-point–penetration relationship; the higher the free acid content of the oil, the nearer did the effect of blending it with the bitumen approach the effect of blending with torbanite gas oil. This effect of the free fatty acids appeared to be decreased by the presence of increasing amounts of ferric chloride, and calculation showed that the major portion of the free acids could be converted to ferric soaps with the proportions used.

The data in Fig 7 showed that, as far as the effect on the fluxing was concerned, it was immaterial whether the ferric chloride was added before or after the blowing. This data, combined with the observations on the addition of ferric chloride and hydrochloric acid to the bitumen (Table I), suggested that the greater part of the action could be explained by the hydrolysis of the ferric chloride allowing the hydrochloric acid liberated to polymerize pyrroles, etc., followed by reaction of the ferric oxide with the free fatty acids to give a ferric soap.

Effect of Soaps on Fluxing

Neutralization of the acid oils with lime before fluxing was found to have some of the effect expected (Fig 8), as was the addition of a number of soaps approximately in the proportions that would be formed by adding acid oil D to bitumen blown with 0·7 per cent of ferric chloride (Fig 9). These latter blends also failed to show adequate ductility until 25 per cent of the oil had been added (Table V). Consequently the influence of the ferric chloride on the fluxing results could be attributed only partly to soap formation.

Some interesting information on the action of soaps was obtained by adding aluminium stearate and gas oil to the bitumen. Without the added gas oil up to 10 per cent of the aluminium stearate had no effect on the softening point (192° F) and only a slight hardening effect on the penetration. When the bitumen had been cut back slightly with gas oil, the aluminium stearate increased the softening point and decreased

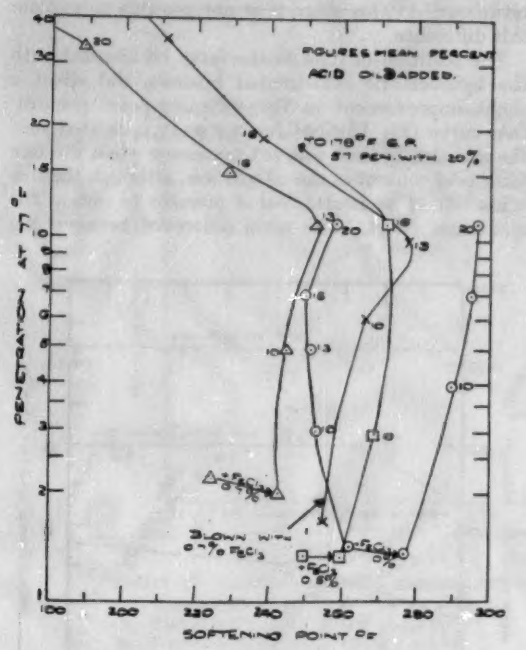

Fig 7

EFFECT OF FERRIC CHLORIDE ADDITION ON FLUXING RESULTS

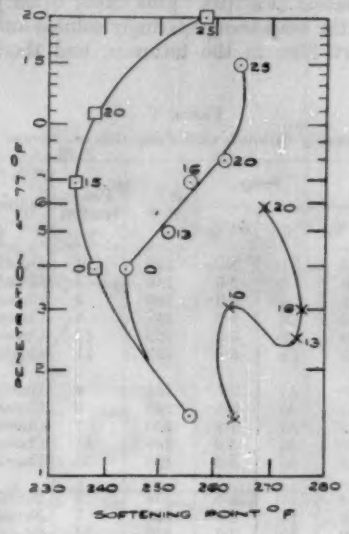

Fig 8

NEUTRALIZATION OF ACID OILS WITH LIME BEFORE FLUXING

× Acid oil B + 8% lime
⊡ Acid oil D
⊙ Acid oil D + 2·5% lime

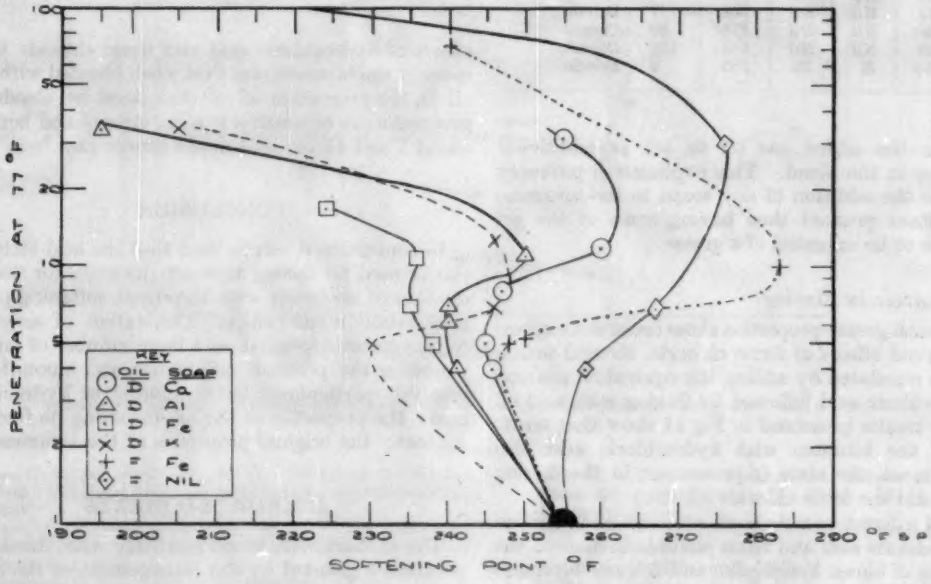

Fig 9

FLUXING BITUMENS WITH FATTY OILS AND SOAPS

the penetration (Fig 10). This effect could possibly be due to the soap being sparingly soluble and acting as an inert filler in the bitumen, and then partly gelling in the added gas oil to act as additional asphaltene in the blend. This explanation probably applies to the addition of any soaps to the bitumen, the resultant product then having some of the gel properties to be expected of a grease.

TABLE V

Fluxing Bitumen with Fatty Oils and Soaps

Oil		Soap		S.P., °F	Penetration	Remarks
Oil	wt %	Type	wt %			
Nil	Nil	Nil	Nil	255	1	Ductile
D	10	Ca	2·5	246	4	Brittle
D	13	Ca	3·3	245	5	Cheesy
D	16	Ca	4·2	247	8	Cheesy
D	20	Ca	5·0	260	12	Cheesy
D	25	Ca	5·0	255	31	Ductile
D	10	Al	2·5	241	4	Brittle
D	13	Al	3·3	240	6	Cheesy
D	15	Al	4·2	240	7	Cheesy
D	20	Al	5·0	249	11	Cheesy
D	25	Al	5·0	195	35	Ductile
D	10	Fe	0·8	238	5	Brittle
D	15	Fe	0·9	235	7	Brittle
D	20	Fe	1·1	236	11	Slightly brittle
D	25	Fe	1·3	224	17	Ductile
D	10	K	2·0	230·5	5	Brittle
D	15	K	2·5	246	7	Brittle
D	20	K	3·0	246	17	Ductile
D	25	K	3·5	205	35	Ductile
F	10	Fe	1·0	248	5	Brittle
F	15	Fe	1·3	250	5	Brittle
F	18	Fe	1·5	283	10	Cheesy
F	25	Fe	1·7	239	70	Very ductile
F	10	Nil	Nil	258	4	Cheesy
F	15	Nil	Nil	266	7	Brittle
F	20	Nil	Nil	276	30	Cheesy
F	25	Nil	Nil	185	132	Ductile
Nil	Nil	K	20	263	8	Brittle

Effect of Acids on Fluxing

Since such grease properties alone could not explain the observed effects of ferric chloride, its acid action was then simulated by adding the equivalent amount of hydrochloric acid followed by fluxing with acid oil D. The results presented in Fig 11 show that treatment of the bitumen with hydrochloric acid also effected much the same improvement in the fluxing curve as did the ferric chloride addition.

It is of interest to note that, although the addition of hydrochloric acid and ferric chloride influenced the properties of blown Venezuelan and Aramco bitumens in much the same manner as torbanite bitumen (Table I), the bitumens thus treated did not show the same type of softening-point–pentration curve when fluxed with the acid vegetable oil as did the torbanite bitumen. At this stage it is not possible to explain this difference.

The addition of lime to the fatty oil blended with the hydrochloric acid-treated bitumen did effect a slight improvement in the softening-point–penetration curve (Fig 12), but further work indicated that the addition of lime was not necessary when the free fatty acid content of the oil was low, although the free acids should be neutralized if possible to obtain the maximum effect. The main difference between the effects of hydrochloric acid and ferric chloride treatment of the bitumen was that when blended with acid oil D, the proportion of oil that could be blended to give a ductile bitumen was more critical and between about 7 and 11 per cent in the former case.

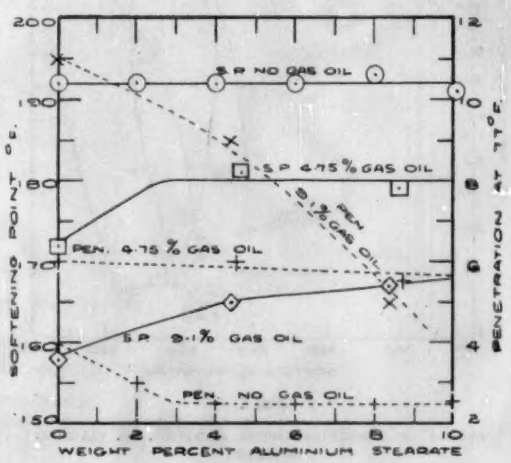

FIG 10

FLUXING WITH GAS OIL AND ALUMINIUM STEARATE

CONCLUSION

In conclusion it can be seen that the acid fatty oils can be used for fluxing torbanite bitumen for the production of materials with improved softening-point–penetration relationships. The extent of any such improvement depended on a large number of factors, including the presence or absence and amount of a catalyst, particularly ferric chloride or hydrochloric acid; the properties of the oil, including its free acid content; the original properties of the bitumen, etc.

ACKNOWLEDGMENTS

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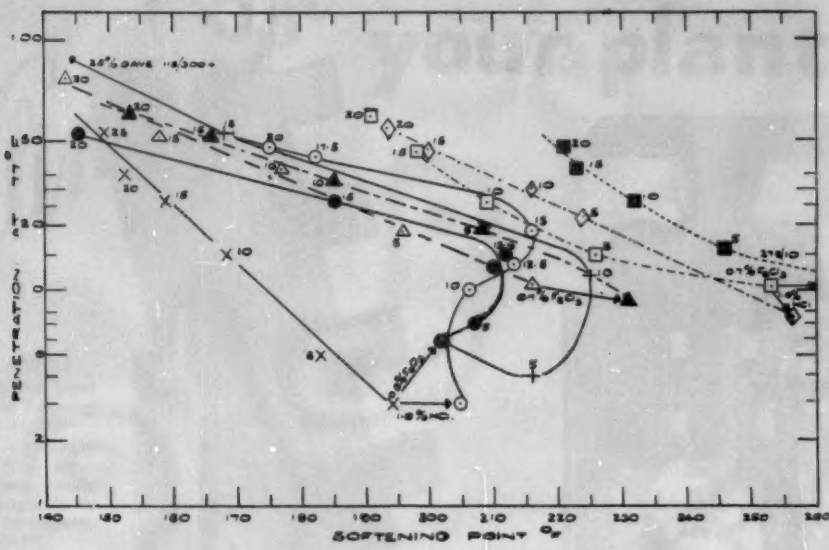

FIG 11

EFFECT OF HYDROCHLORIC ACID AND FERRIC CHLORIDE ON FLUXING DIFFERENT BLOWN BITUMENS

× Torbanite bitumen + D
○ Torbanite bitumen + HCl + oil D
● Torbanite bitumen + $FeCl_3$ + oil D
+ Torbanite bitumen + $FeCl_3$ + oil F
⊡ Venezuelan bitumen + oil D
◈ Venezuelan bitumen + HCl + oil D
▲ Aramco bitumen + oil D
△ Aramco bitumen + $FeCl_3$ + oil D
■ Venezuelan bitumen + $FeCl_3$ + oil D

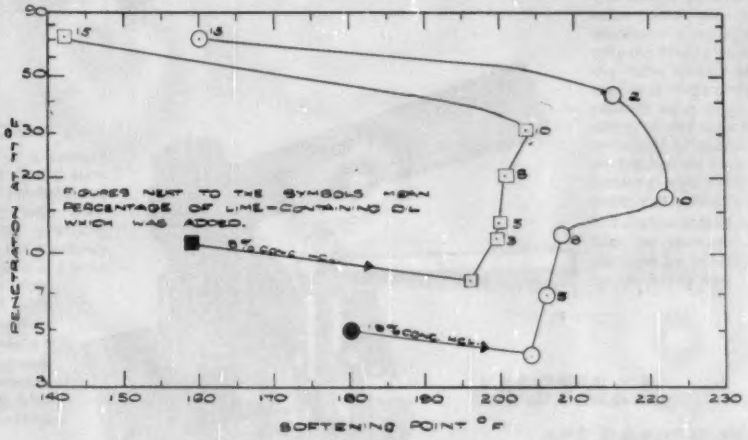
FIGURES NEXT TO THE SYMBOLS MEAN PERCENTAGE OF LIME-CONTAINING OIL WHICH WAS ADDED.
PENETRATION AT 77°F
SOFTENING POINT °F

FIG 12

TORBANITE BITUMEN TREATED WITH HYDROCHLORIC ACID AND BLENDED WITH ACID OIL D AND LIME

References

1 Blore, G. B., and Somerville, W. B. "Oil Shale and Cannel Coal," Vol. 2, pp. 180–5. London: Institute of Petroleum, 1951.

2 Forbes, C. E., and Somerville, W. B. "Oil Shale and Cannel Coal," Vol. 2, pp. 428–39. London: Institute of Petroleum, 1951.

3 Robertson, G. G. "Oil Shale and Cannel Coal," Vol. 2, pp. 571–83. London: Institute of Petroleum, 1951.

4 Pfeiffer, J. Ph. "The Properties of Asphaltic Bitumen." London: Elsevier, 1950.

5 Bitumen Binder Research Unit, South African C.S.I.R., Report B.N./55, Sept 1953.

6 Taylor, T. W. J., and Baker, W. "Sidgewick's Organic Chemistry of Nitrogen," Chap. 17–18. Oxford: Clarendon Press, 1937.

7 Hurd, C. D. "Pyrolysis of Carbon Compounds," A.C.S. Nomograph No. 50, Chap. 23. New York: Chemical Catalogue Publishing Co, 1929.

8 Pfeiffer, J. Ph., and Saal, R. N. J. *J. Phys. Chem.*, 1940, **44**, 139.

9 Pfeiffer, J. Ph. "The Properties of Asphaltic Bitumen," pp. 153–4. London: Elsevier, 1950.

10 Pfeiffer, J. Ph., and van Doormal, P. M. *J. Instn Petrol. Tech.*, 1936, **22**, 414.

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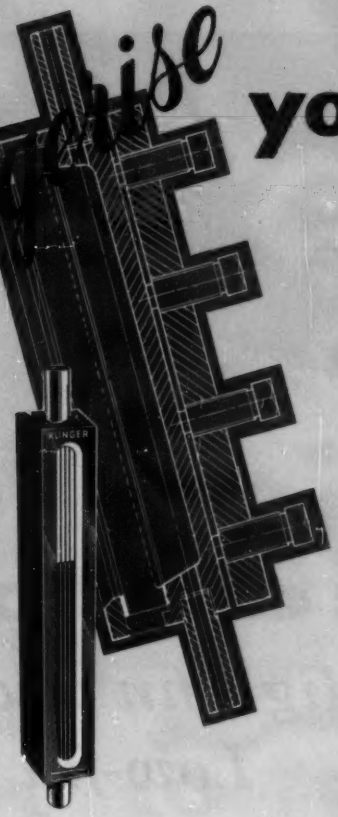

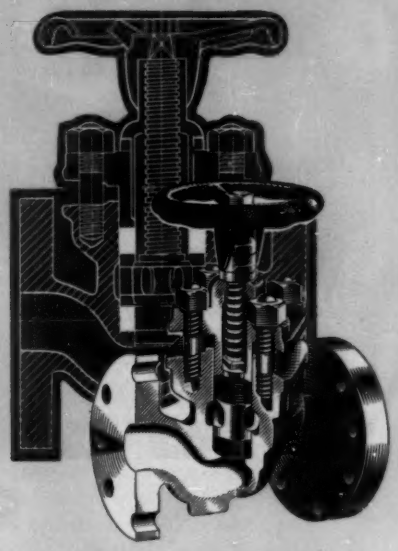

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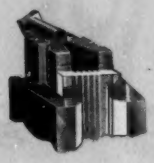

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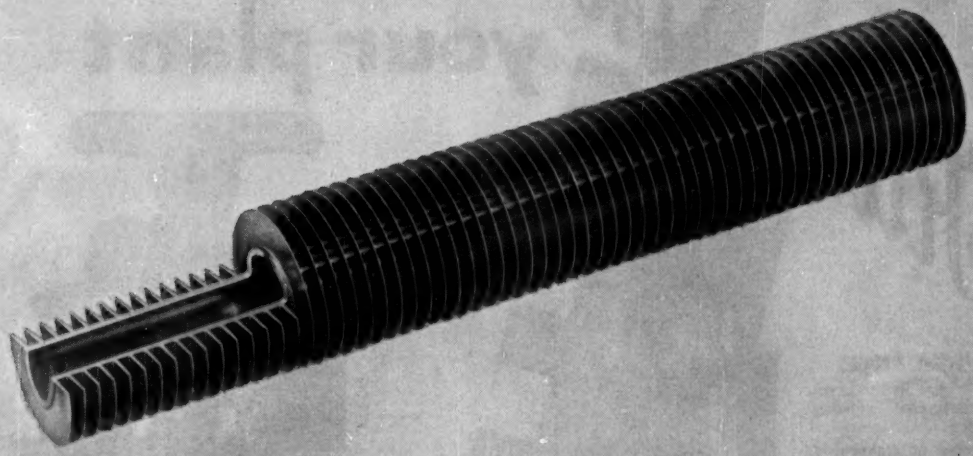

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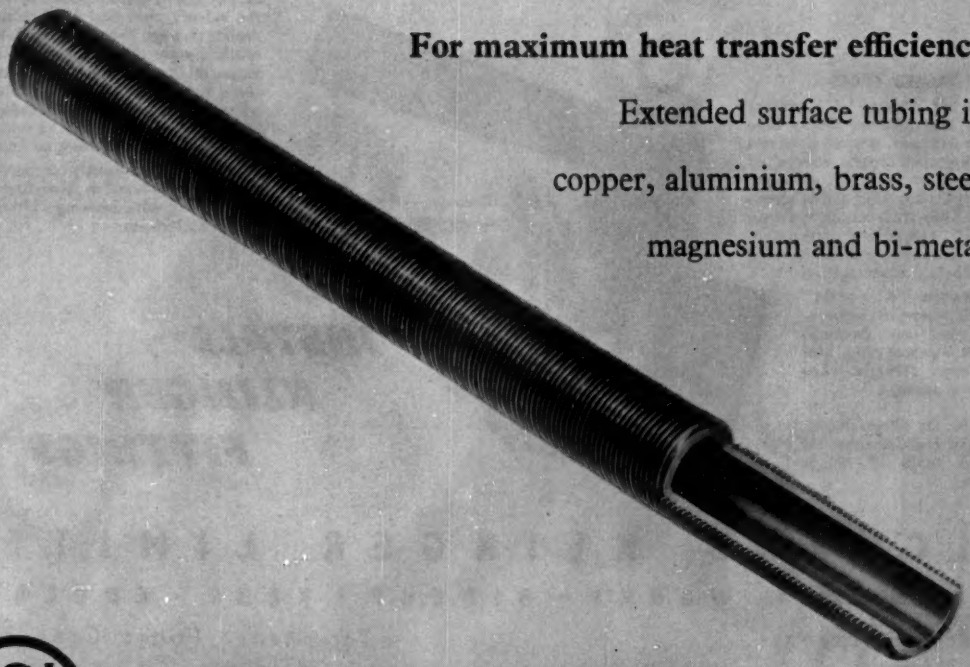

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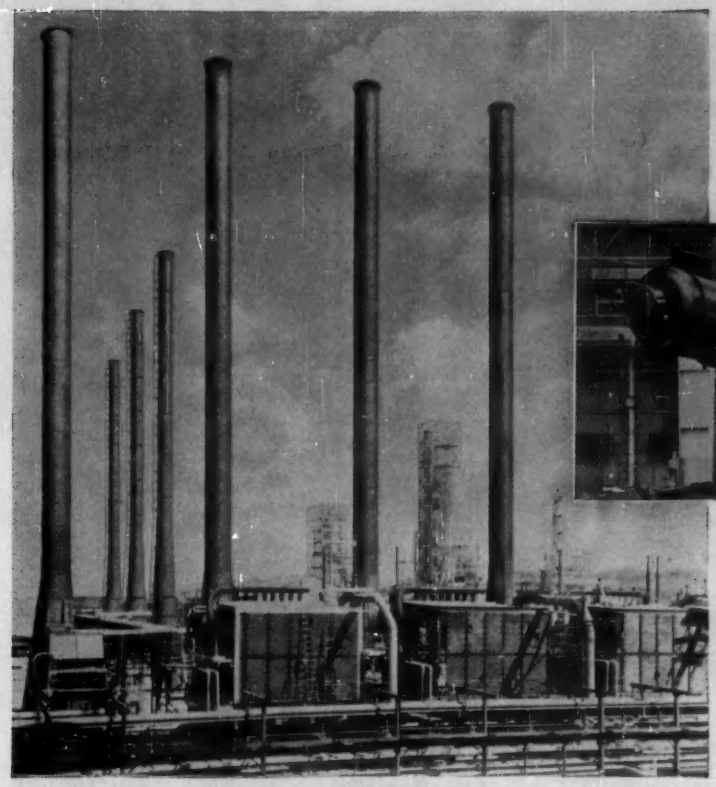
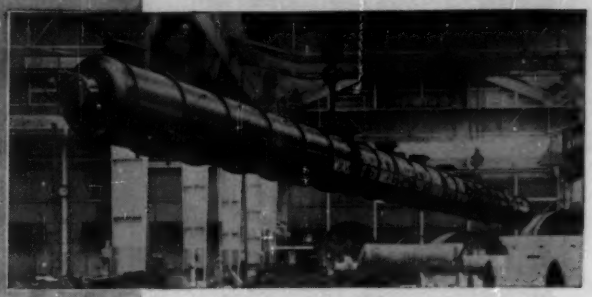


(left)
Babcock oil-fired boiler plant at Burmah-Shell refinery, Trombay, India.



(above)
Babcock fusion-welded treating tower for a Scottish chemical plant.

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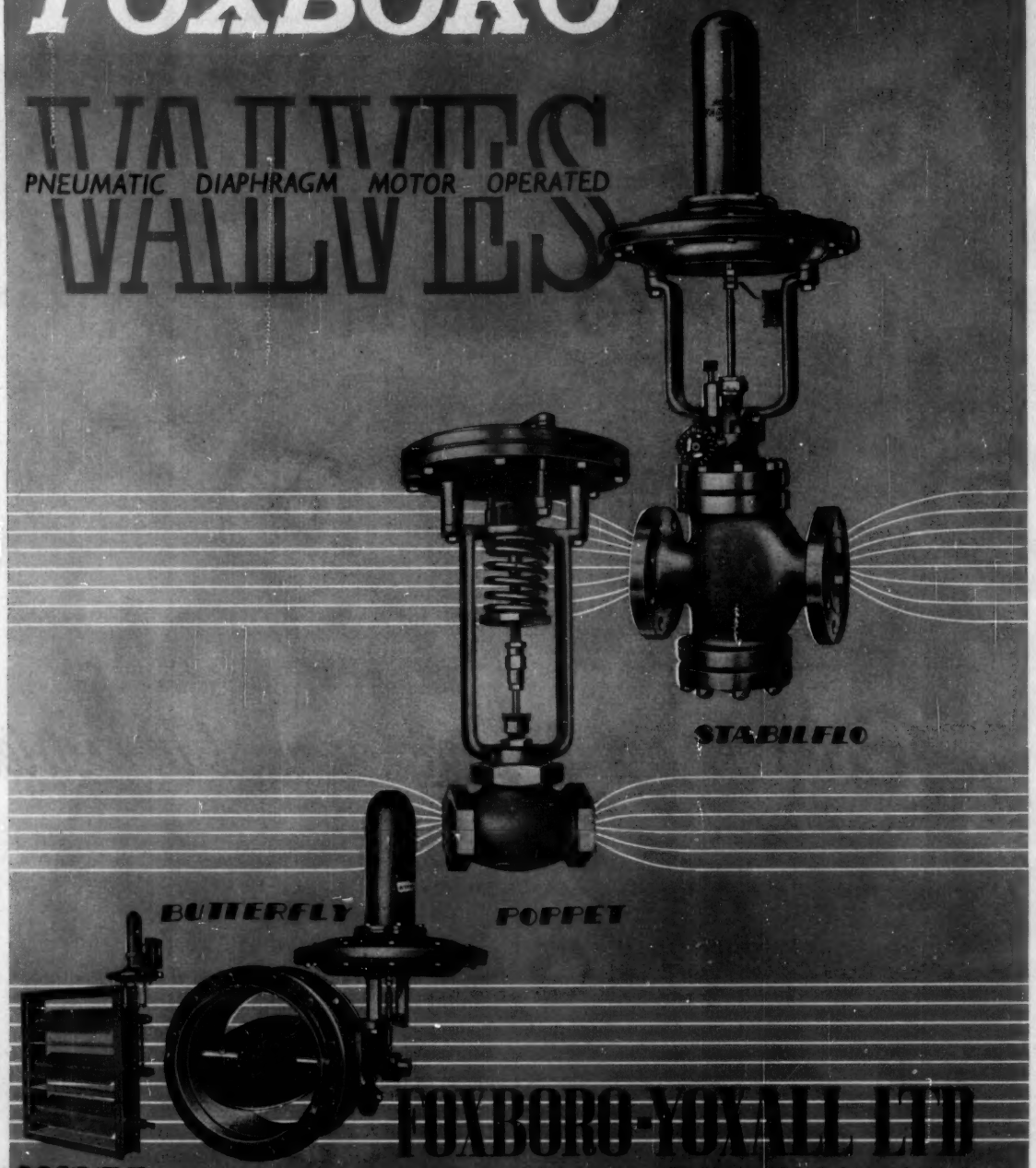

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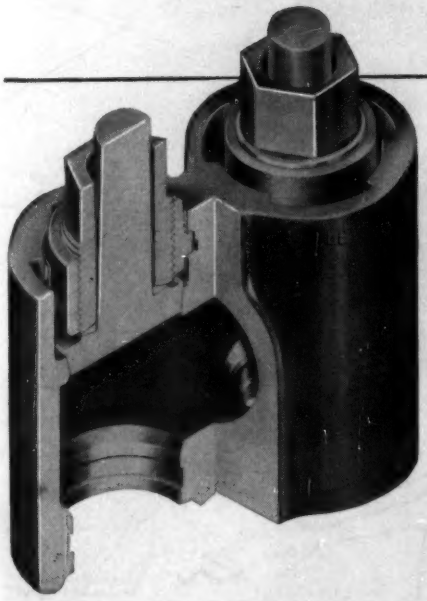

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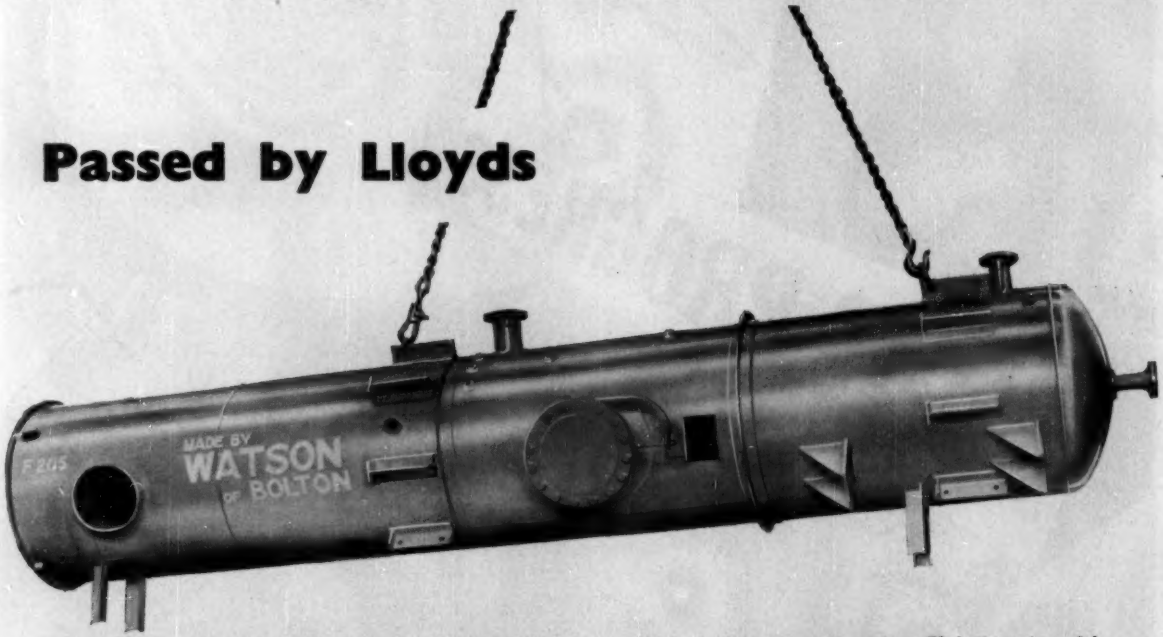

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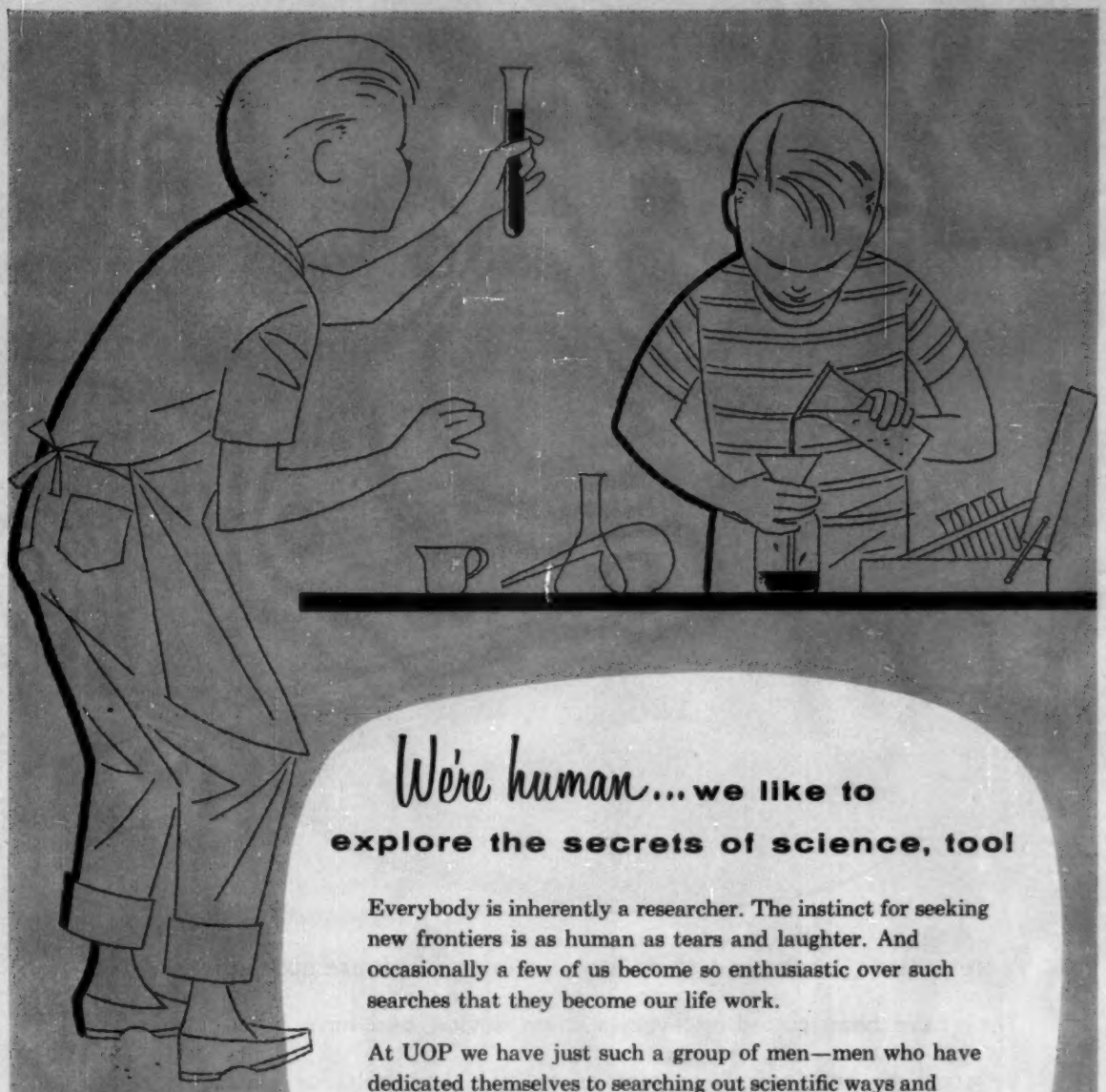

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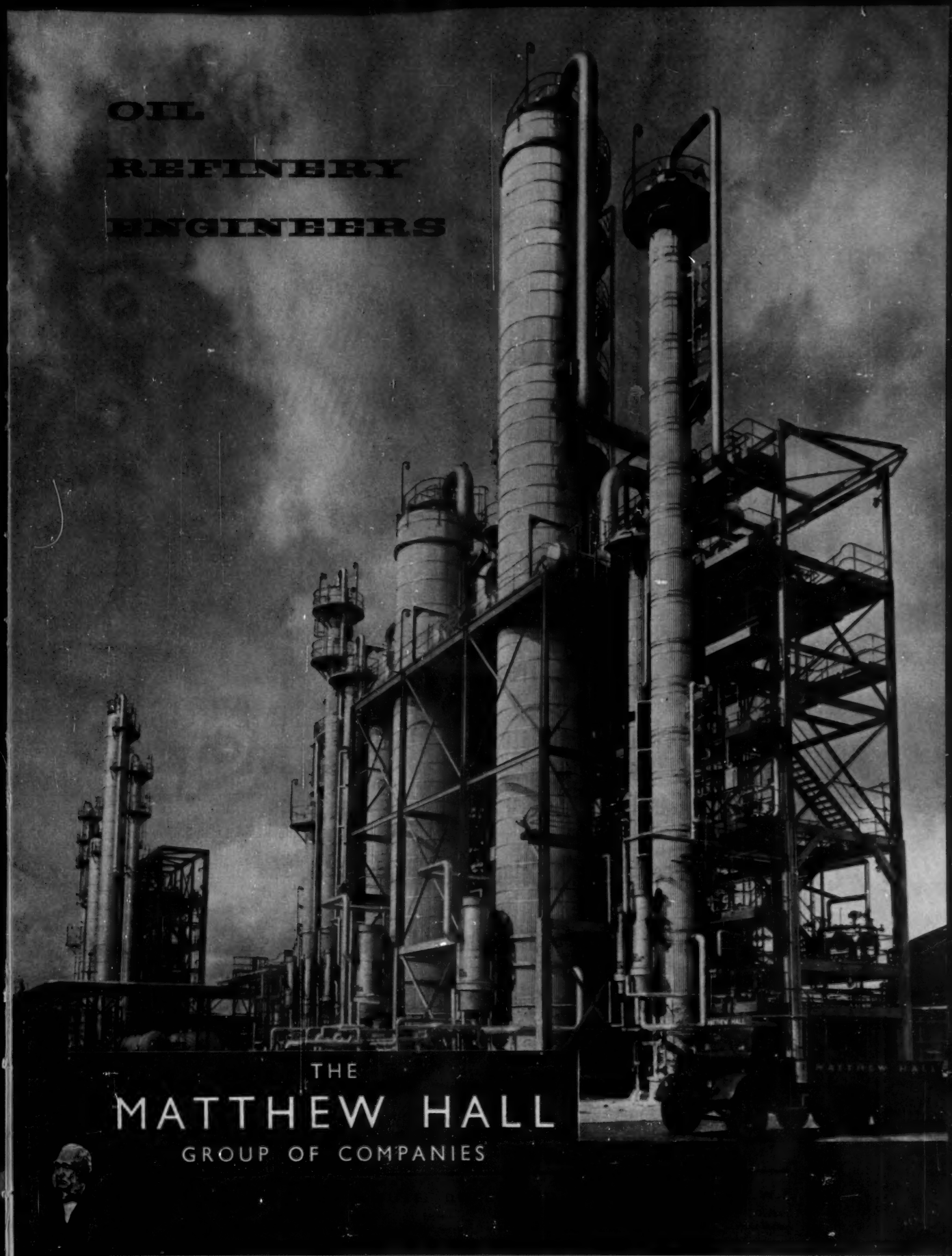
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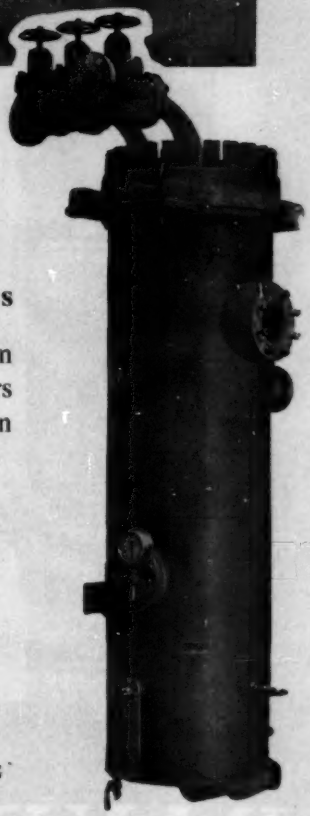

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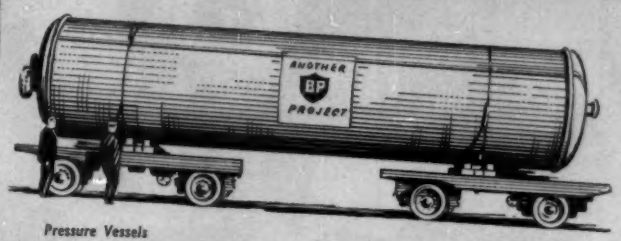

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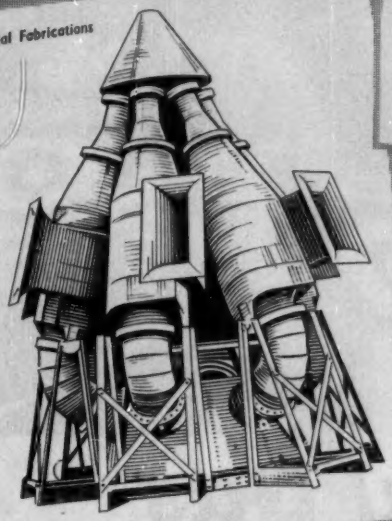

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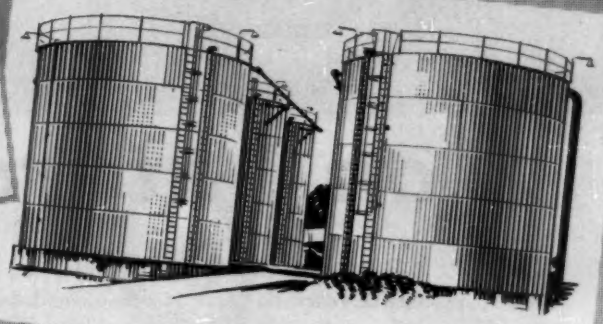

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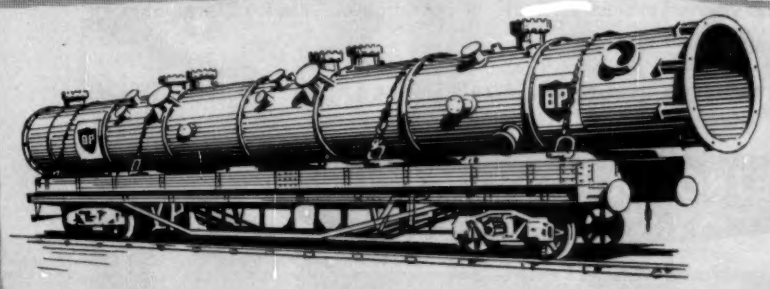

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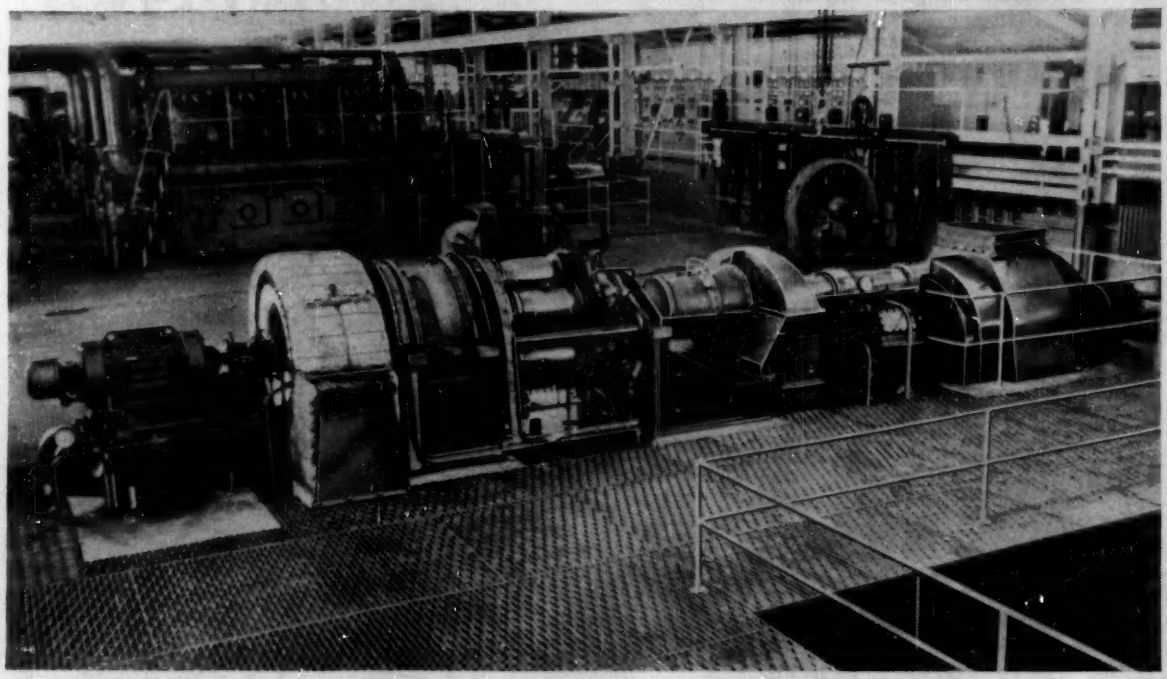

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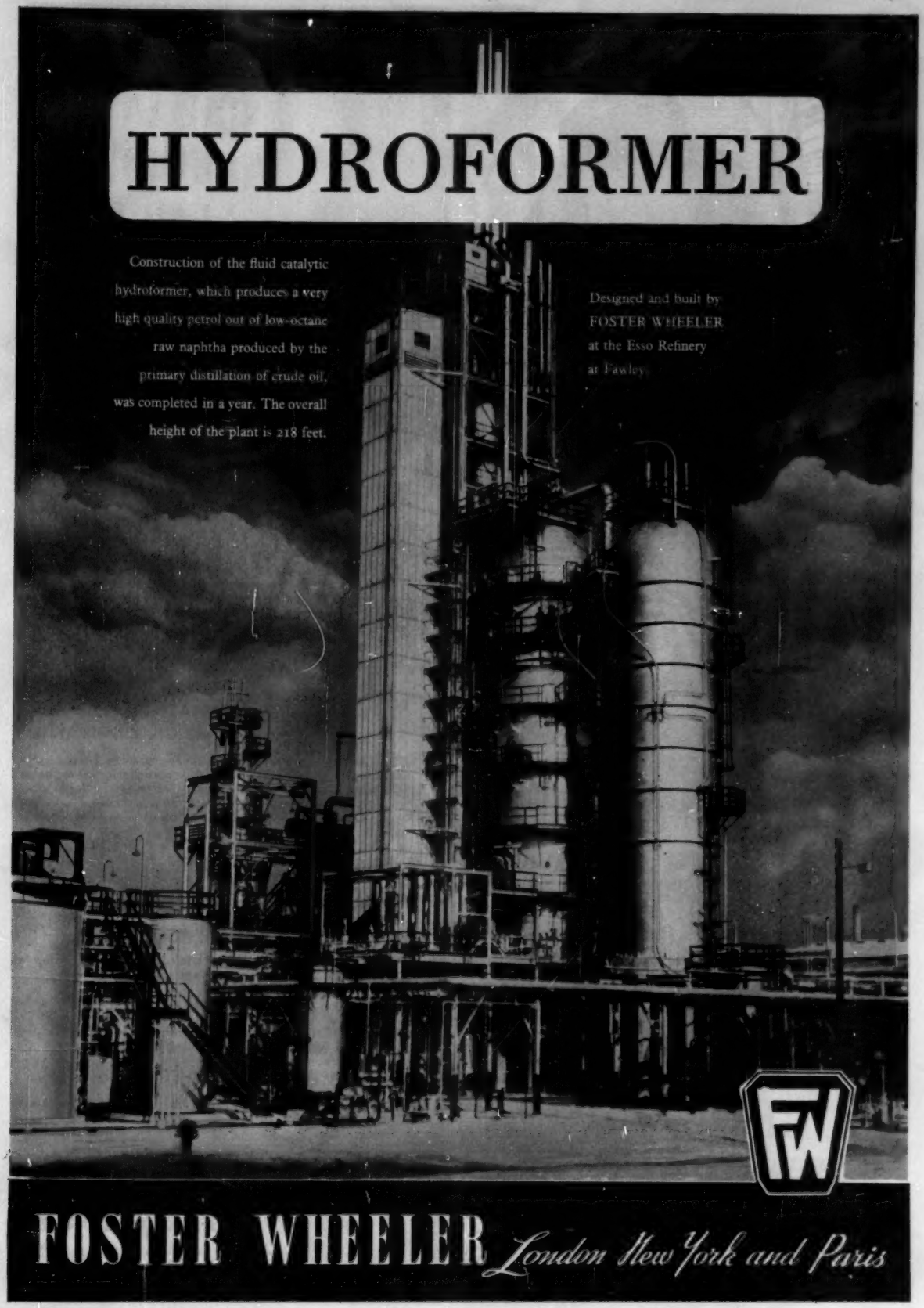
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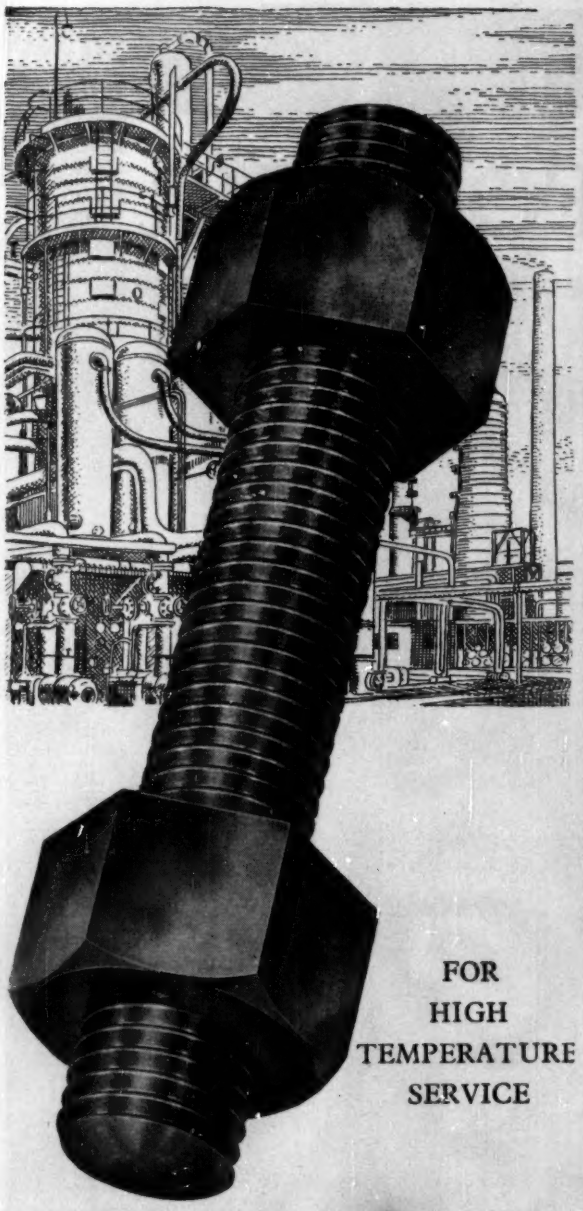

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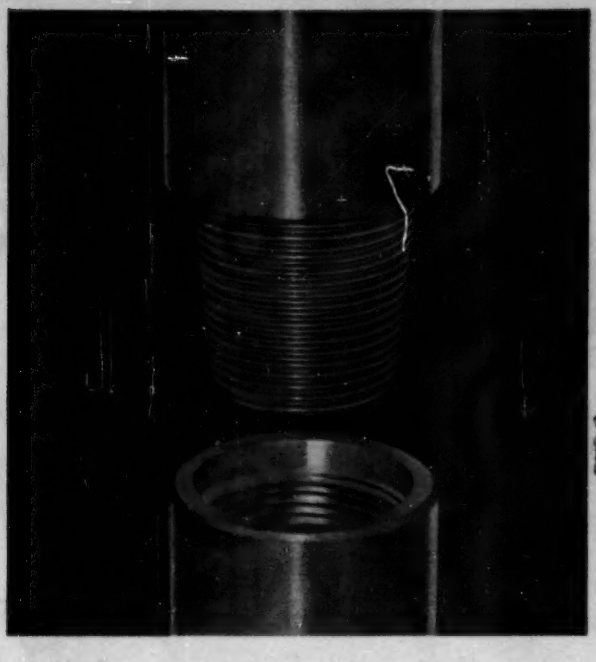

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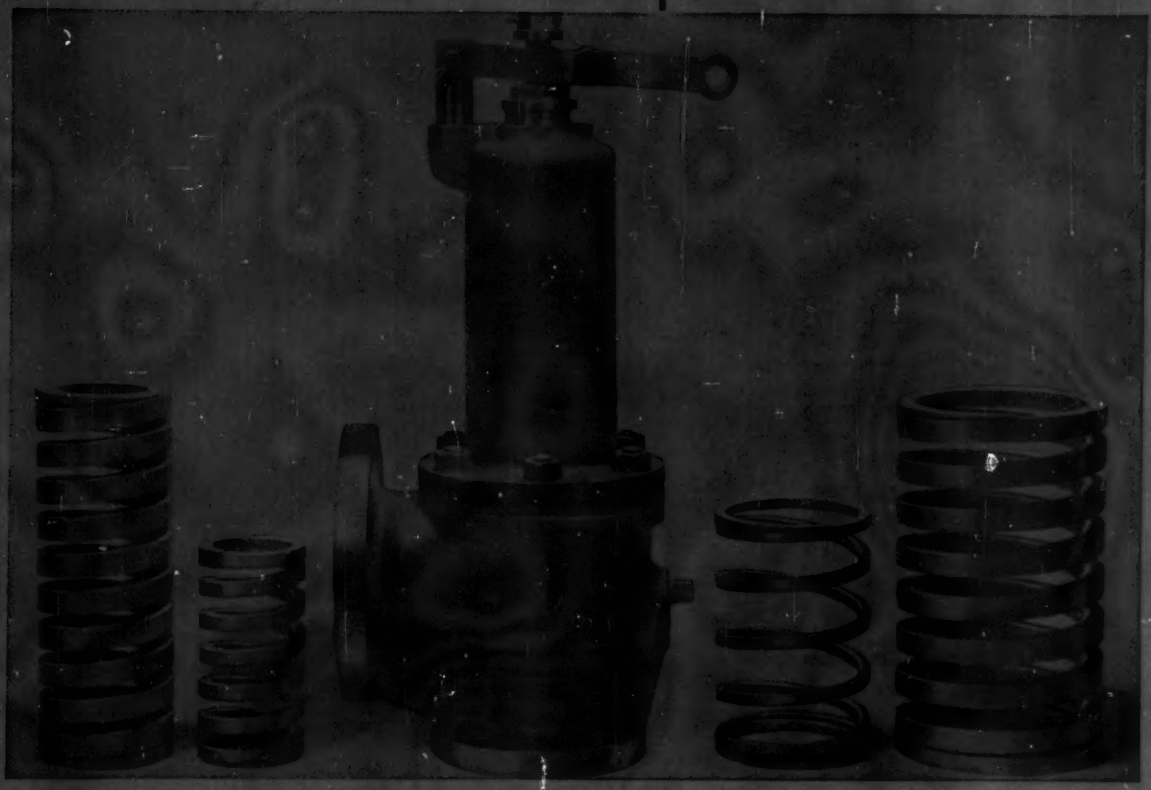

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1. Views on Ernst Kraus' theories of mountain formation. H. von Gaertner. *Erdöl u. Kohle*, 1955, **1** (1), 3.—Ernst Kraus has recently summarized his theories on mountain formation based on underground movements at different levels. A critical discussion of these theories is given. W. W. G.

2. Another frontier falls before the drill. F. J. Gardner. *Oil Gas J.*, 11.7.55, **54** (10), 169.—Oil has been found on the Las Animas Arch in SE. Colorado by 1 Cordes and Oberlander in 2 Lower Pennsylvanian sands, and the well has been completed as a dual producer. Previous attempts to find commercial production on the arch have been unsuccessful, although there have been reported shows of oil and gas. Las Animas is a broad anticline which was clearly defined by late Des Moines, and accentuated during late Pennsylvanian and Permian. Further movement during the Mesozoic and Tertiary is indicated, and on the W. of the arch much of the sequence from Permian to Cambrian is missing, suggesting the possibility of wedge-out traps on the flanks. C. A. F.

3. An old pay with a future. J. Sanford and G. Shearrow. *Oil Gas J.*, 4.7.55, **54** (9), 156.—The development and future possibilities of Trenton limestone production in the Great Lakes and Appalachian areas is discussed. Exploration has been mainly concentrated in areas where the Trenton is relatively shallow, and it is suggested that the formation has not been adequately tested.

Production is localized by fracture and solution porosity and in places by dolomitization, and the oil may be indigenous to the rock. In the Northville area the following sequence can be observed: fracturing, solution, and development of cavernous porosity in the fractured zones, deposition of dolomite crystals along the margins of the cavities, and invasion of the remaining porosity by hydrocarbons. C. A. F.

4. An old area learns new tricks. F. J. Gardner. *Oil Gas J.*, 18.7.55, **54** (11), 143.—Future oil possibilities of the Appalachian area are outlined, and 5 prospects are suggested: thrust fault prospects in the SE. basin, stratigraphic traps on the flanks of the Adirondack arch and the possibility of a separate basin to the E. of it, deeply buried stratigraphic traps in the Palaeozoic where the beds wedge out on the E.

flank of the Cincinnati Arch, Silurian and Devonian pools beneath the E. half of Lake Erie, and Silurian and Ordovician fields on subsidiary folds radiating from the Cincinnati–Algonquin geanticline.

There are over 20,000 ft of sediments in the basin, which is 700 miles in length and has been hardly tested below 8000 ft.
C. A. F.

5. Drill may provide answer to Michigan's 64-dollar question. J. C. McCaslin. *Oil Gas J.*, 4.7.55, **54** (9), 155.—Oil has been discovered in the Silurian Niagara in the Northville field in SE. Michigan; this is the first commercial production from the Niagara to be found outside Ohio.

Northville, which also produces from the Trenton, is on a sharp anticlinal fold trending NW.–SE., and production is partially controlled by dolomitization, which provides secondary porosity near the crest of the anticline. It is hoped that further deep Trenton and Niagara pays will be found in the SE. part of the state. C. A. F.

6. Why subthrust production is promising. N. S. Morrisey and J. L. Walper. *Oil Gas J.*, 11.7.55, **54** (10), 116.—Several fields have recently been found in S. Oklahoma, where the accumulations occur below thrust or reverse faults; these are located on trends along which similar conditions may exist.

The geology of the Eola and Gotebo fields, which produce from subthrust zones, are outlined, and it is recommended that the possibilities of closure against the downthrown sides of reverse faults should be considered in the interpretation of other structures in the general area.

Cross-sections of the Eola and Gotebo fields are included.
C. A. F.

7. Strat-trap strikes revive an old field. D. H. Stormont. *Oil Gas J.*, 11.7.55, **54** (10), 170.—The discovery of a stratigraphic accumulation in the Guijarral Hills field, Fresno County, California, is described. The field is on the SE. flank of a large anticlinal structure with which several Coalinga fields are associated. Much of the new production is due to an extension of the Leda sand (Lower Miocene) on the N. edge of the field, where 38 wells have been completed in 18 months.

Accumulation at Guijarral Hills is controlled by lensing and overlapping of Miocene and Eocene sands on the SE. plunging Coalinga anticlinal nose. Further stratigraphic traps along the flanks of the structure are being sought.
C. A. F.

8. Gasser blows out. Anon. *Oil Gas J.*, 18.7.55, **54** (11), 80.—A wildcat, nr Logbaba, in the French Cameroons has discovered high pressure gas. The well, LA 101, on test indicated a possible normal gas flow of 35,000 M.c.f/day from sand at *ca* 5800 ft.

Exploration in the area has been carried out since 1952, and over 20 wells have been drilled which indicate Eocene unconformably overlying folded Palæocene and Upper Cretaceous. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

9. European Association of Exploration Geophysicists. A. T. Dennison. *Nature, Lond.*, 1955, **175**, 583.—Summaries are given of some of the 22 papers presented at the seventh meeting of the Association, held at The Hague, Dec. 1954. None was concerned specifically with oil prospecting. H. C. E.

DRILLING

10. Calibration of gamma-ray diagrams. E. Blum. *Erdöl u. Kohle*, 1955, **1** (1), 5.—A method is given of calibrating γ-ray diagrams obtained in the electric logging of wells during drilling. The method is based on the use of suitable zero lines for radiations from known formations. W. W. G.

11. New classification for oil and natural gas wells in Germany. Hanover Geological Society, Petroleum Division. *Erdöl. u. Kohle*, 1955, **1** (1), 2.—The old classification of oil wells made in 1936 does not correspond with the latest international system (F. H. Lahee, *Bull. Amer. Assoc. Petrol. Geol.*, 1954, **38**, 972). In the autumn of 1954 a committee, including representatives of the German oil companies, under the direction of the Hanover Geological Society, worked out a new scheme of classification and of definitions for oil and natural gas wells which came into force on Jan. 1, 1955. Details of the new classification are tabulated and compared with the corresponding international terms given in English. W. W. G.

12. Inclined drilling: principles and application in Yugoslav practice. II. N. Cizmic. *Nafta* (*Yugoslavia*), 1955, **6** (7), 213–26.—In the second part of his reflections the author gives a rough survey of the machinery employed for controlled directional drilling. In connexion with this an analysis of the procedure of fixing the tool direction is laid out and the methods of orientation of the tool at the well bottom are developed. Finally, the procedure and the individual phases of deviation with the use of whipstock and knuckle joint respectively are described. The paper ends with a survey of rock bit tools employed in directional drilling. (Author's abstract.)

PRODUCTION

13. A simple treatment of flood waters. W. Greve. *Erdöl u. Kohle*, 1955, **1** (1), 7.—A scheme is outlined for a method of treating flood waters from oilfields, the method being modified according to the actual composition of the water. The crude oil present (in the form of a water-in-oil emulsion) is separated either by chemical dehydration at 50° C or by electrical treatment at 100° C. The subsequent process varies according to the form in which iron is present in the water.
W. W. G.

14. Hydraulic fracture of an oil-bearing stratum. Yu. P. Zheltov and S. A. Khristianovich. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk*, 1955, (5), 3–41.—Discussion, largely mathematical, of factors involved in formation of horizontal and vertical fissures and of fluid pressures necessary therefor. (From author's summary.)

15. Mutual interference between wells under flexible conditions of filtration of crude. M. I. Shvidler. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk*, 1955, (5), 42–9.—An approx solution is derived for the 2 cases of a straight infinite chain of wells in an infinite stratum and for the case of a circular battery of wells in an infinite stratum.
(From author's summary.)

16. Effect of pressure on changes in the wettability of minerals in petroleum deposits. M. A. Geiman, V. B. Shneerson, and A. G. Mamikonov. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk*, 1955, (6), 127–39.—Calcite is treated with toluene and toluene soln of various crudes; wettability with H_2O is examined at 18°–25° C, 1–350 kg/cm² in N_2; more restricted tests are also done in CO_2. In N_2 little change in wettability to 50 kg/cm², then improved to max at 150 kg/cm², decreasing thereafter to fall below atm pressure val at 250–300 kg/cm². In CO_2 wettability rises to 50 kg/cm², max test pressure used. In absence of adsorbed oil film (*i.e.* calcite treated with toluene alone) wettability decreases with increasing pressure. Description, with diagrams, of test equipment used. V. B.

17. Some problems of crude oil production in the People's Republic of Croatia and perspectives of its further development. J. Vuckovic. *Nafta* (*Yugoslavia*), 1955, **6** (6), 180–90.—The paper comprises a brief historical survey of crude oil production development in the People's Republic of Croatia, including also a detailed analysis of the period after the second world war to 1954. In this review, a survey is given of the movement of industrial reserves of crude oil as well as capacities of exploratory and production drilling, also the history of

crude oil production during this period in Croatia. The enterprise "Naftaplin," Zagreb, has been given concessions for exploration and exploitation in the whole territory of Croatia, so all the problems discussed in the paper refer to this enterprise. Areas of Croatia where, by 1954, the activity of industrial production of crude oil was developing, are shown in enclosed maps. In proportion to the results obtained by now, the whole territory has been divided according to prospectiveness, and the degree to which individual areas have been explored is also given in the article. The paper also deals with perspectives of further development of crude oil production in Croatia, as well as with measures that ought to be taken in order to further increase production of crude oil and natural gas in that part of the country. (Author's abstract.)

OILFIELD DEVELOPMENT

18. Field operations in Louisiana's marshes. Anon. *Oil Gas J.*, 11.7.55, **54** (10), 122.—The geology and drilling and development problems of the Venice field, *ca* 90 miles S. of New Orleans, are briefly described. The surface is at sea level, and full use has been made of marine facilities, canals being dredged to each location and equipment transported by barges.

Oil occurs in approx 37 sands ranging from 3500 to 14,700 ft and upturned against a piercement salt dome. The discovery well was drilled in 1937. Casing on all wells is set to total depth, and sands are opened by perforating the casing. Most of the reservoirs produce under an active water drive and the wells flow to near depletion; after flow, further recovery is obtained by using gas-lift flow valves. C. A. F.

19. Aramco production down. Anon. *Oil Gas J.*, 11.7.55, **54** (10), 102.—Production from Saudi Arabia in 1955 is expected to be less than in 1954.

In the Ghawar field exploration wells indicate that it includes the Haradh field to the S., proving *ca* 130 miles of continuous production comprising 5 areas. 3 areas are producing from 141 wells, with an averaged yield of over 6600 b.d/well. Pay thickness averages *ca* 142 ft.

Production in the Safaniya field is expected to be developed by 1957, and a pipeline from the field to Ras Tanura is planned. C. A. F.

TRANSPORT AND STORAGE

20. Foam roof cuts product losses. Anon. *Petrol. Process.*, 1955, **10** (6), 857.—Standard Oil Co (Ohio) report that loss of gasoline by evaporation when stored in cone-roof tanks can be cut by as much as 60% through the use of "Microballoons." Microballoons are hollow, microscopically small, gas-filled plastic spheres which float on the surface of a liq stored in tank and form a foam-like seal. They are commercially available in 2 forms—urea resin and phenolic resin. J. H.

21. Plastic pipe for underground structures. R. B. Seymour. *Corrosion*, 1955, **11** (7), 322–7t.—Data are given on the physical properties of pipe made from epoxy-glass, polyester-glass, cellulose acetate butyrate, polyethylene, styrene–rubber, and polyvinyl chloride, together with extensive information on their resistance to natural and artificial gas, salts, caustics, petroleum crudes, and hydrochloric acid. Impact and temp characteristics are also reported. W. G. R.

22. Method of locating interfaces in oil pipelines. D. B. Smith and G. R. Church. *Nature, Lond.*, 1955, **176**, 223.—Hydrogen contents of bulk liq may easily be compared by the use of a neutron-scatter or transmission technique. A portable source of fast neutrons can be placed outside the pipeline; the neutrons entering the liq are moderated by scattering from the H atoms, and the concn of slow neutrons which emerge from the pipe will be dependent on the H content of the liq in the pipe. These can be measured with standard equipment incorporating a BF_3 counter.

Lab tests indicate that the technique can differentiate between premium and commercial grade fuels by a 5% change in reading: a further 10% change occurs between commercial fuel and kerosine. If the 2 liqs have the same H content the interface can be labelled with minute amounts of boron or gadolinium salts which absorb slow neutrons very strongly. H. C. E.

23. Using "controlled fire" to repair gas lines. H. W. Gavin. *Oil Gas J.*, 26.9.55, **54** (21), 267.—Method is to allow a little gas to escape through the cut or weld in pipe and to burn while work is in progress, after isolating section and reducing to almost zero pressure. Amount of gas escaping is controlled by blow-off stacks and valves installed near point of cut. G. A. C.

24. The Sui gas pipeline. G. McHardy and R. C. J. Windebank. *Petroleum, Lond.*, 1955, **18** (9), 341.—The route for this pipeline was known to be corrosive to some extent, and consequently a corrosion survey was carried out as follows. Following aerial photographic survey, the soil resistivity was measured at varying depths by an earth megger, using the 4-pin method, at intervals of 5 miles. Chemical and microbiological analysis of soil samples confirmed the survey observations of the corrosive nature of the route. J. B. S.

25. The case for the 37½° bevel. R. G. Strong. *Oil Gas J.*, 19.9.55, **54** (20), 123.—Reasons for preference of a 37½° bevel instead of a 30° one are given, for pipeline welding; and recommendations are made for its adoption as an accepted standard. G. A. C.

26. Staffelfelden crude despatch station at Wittelsheim railway station. H. Innocent. *Bull. Ass. franç. Tech. Pétrole*, 1955, (113), 469–80.—Small production (100 tons/day) for limited period (3–4 years), is intended for refinery 150 km away. Cost comparison shows considerable saving in favour of rail against road. 3 km of 2½-inch line connects field to railway station, 28-ton tank cars, 18-car train loaded in 9 hr by a crew of 2. Details (illustrations) of pumps and loading equipment, one week's storage is provided at rail siding. V. B.

27. Our half-yearly review of the world's tanker fleet. Anon. *Petrol. Times*, 16.9.55, **59** (1516), 957.—Recent trends are analysed, and economics of conversion of tankers into ore carriers are reviewed. Tables show world tanker tonnage, transactions, conversions, and breaking-up. G. A. C.

28. Marine terminal completed. J. Stumm. *Petrol. Engr*, 1955, **27** (7), C12.—The building of the Union Oil Co's marine terminal at Oleum to replace the one destroyed by fire in 1952 is described in detail. As well as structural details, hose handling, fire protection system, instrumentation, and control are all discussed. J. B. S.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

29. Non-destructive testing of refinery equipment. T. C. Wilson. *Petrol. Engr*, 1955, **27** (7), C16.—Radiography, ultrasonic instruments to establish thickness of vessels, magnetic particle inspection, and fluorescent penetrants to locate surface and sub-surface defects are examples of new methods of testing equipment. These newer methods of inspection shorten off-stream time of vessels and lines, reduce costs, and increase safety of both personnel and equipment, but they should not replace the older methods, such as drilling and plugging weep holes, calipering, and visual inspection.
J. B. S.

30. Developments in fractionator design. F. W. Winn. *Petrol. Engr*, 1955, **27** (10), C10.—2 research groups have been established for obtaining reliable information on vapour–liq contacting devices. Fractionation Research Inc's programme is being conducted with large size columns—a 66-inch, 3-tray simulator and a 48-inch, 10-tray unit. Studies are being made of pressure drop, flooding, hydraulic gradient, entrainment, etc. The other group is studying the effect of system properties and tray design on efficiency. A brief account is given of new type trays recently available, including Uniflux, Nutter, Flexitray, Nord, etc. J. B. S.

31. Vapor-phase cooling of gas compressors. C. D. Long. *Oil Gas J.*, 5.9.55, **54** (18), 121.—United Gas Pipe Line Co uses vapour-cooling facilities on 5 compressor engines at its Aqua Dulce station to reduce waste heat and convert it into useful work, and take advantage of the benefits of such cooling in use of an adverse engine fuel. G. A. C.

32. Design characteristics of extended surface-type heat exchangers. A. C. Brown. *Petroleum, Lond.*, 1955, **18** (9), 338.—Theoretical considerations in the design of finned-tube-type heat exchangers are discussed with particular reference to the modifications to the usual formula for evaluating the overall heat transfer coeff, due to the extended surface of the tube. The many duty requirements which can best be solved by this type of heat exchange equipment are also considered.
J. B. S.

33. C.O. boilers and waste-gas eliminators. O. F. Campbell. *Oil Gas J.*, 29.8.55, **54** (17), 109.—Sinclair Refining Co is building a C.O. boiler with cyl furnace recovering heat from regenerator flue gas and a re-spray steam superheater immersed in the fluidized bed of the regenerator to control the bed temp while superheating the steam from the waste-heat boiler, thus obtaining max fuel economy. G. A. C.

34. Total demineralization treatment of feed water for high pressure boilers. P. Bourbillon. *Bull. Ass. franç. Tech. Pétrole*, 1955, (113), 447–68.—Principles of ion-exchange water treatment are outlined and a description (flow-diagrams) given of use of Amberlite resins for water treatment (feed 28° hardness) at Dunkirk refinery, where 3 boilers (each 50 tons/hr) operate at 65 kg/cm² and 485° C. Annual resin make-up is 5–10%, treatment cost (1954, excluding cost of feed water and depreciation) 60 frs/m³. Boilers have operated 30,000 hr without internal cleaning, flushed every 10 months. V. B.

35. Symposium: Pumps for the chemical industry. Operation of steam ejectors. J. Wiegand. *Ingenieur, 's Grav.*, 8.7.55, **67** (27), Ch 61–4. **Steam ejectors in vacuum technology.** J. Wiegand. *Ibid.*, Ch 64–1.—The author discusses steam ejectors in their capacity as gas pumps. After a brief description their operation is explained by means of the H/S diagram. 2 types of efficiency are formulated. The "internal" efficiency allows the mutual comparison of ejectors, whereas the "external" efficiency compares the steam ejector with other steam-driven plant, *e.g.* turbo compressors. A valuable operating characteristic is obtained when for constant pressure of driving steam and entrained vapour the ejector throughput is plotted *v.* the back pressure. It can be seen that the stability is least when the ejector is working at its max efficiency.

In the second paper a distinction is made between the use of steam ejectors as vacuum pumps and as heat pumps. Multistage ejectors are required for high vacua, and steam economy is obtained by the use of intermediate water-jet condensers. In the application of the ejector as a heat pump, the object is either to increase the pressure and therefore the temp of waste steam so that it can be used in secondary processes or to increase the pressure of water vapour from high vacuum systems so as to allow its condensation. The economics of ejector-driven cooling installations are discussed. The paper ends with a discussion. 10 figs. (In German.) G. F. T. C.

36. Mechanical engineering. Pt I. The choice, design, characteristics, and maintenance of centrifugal pumps. F. B. Applegate. *Petrol. Engr*, 1955, **27** (7), C19.—An understanding of the mathematical, engineering, metallurgical, and practical reasons behind pump design extends the knowledge of pump buyers and users. The physical laws controlling the design and performance of pumps are given, and also the characteristics of different types of centrifugal pumps.
J. B. S.

37. An economic analysis of water treatment. M. C. Forbes. *Petrol. Engr*, 1955, **27** (10), C34.—By carefully selecting the best method of water treatment, savings can be made that overshadow the cost of treatment. Economic losses caused by ineffective water treatment are associated with prolonged shut-down for cleaning and repair, and damage by corrosion, which shortens plant life. Specific problems in cooling water treatment are microbiological, scale, and corrosion control, in that order. The various methods of treatment are outlined, and typical examples of the savings possible given.
J. B. S.

38. Your key to maintenance savings. R. J. Stratmeyer. *Chem. Engng*, 1955, **62** (9), 173.—A method of reducing maintenance costs by grouping of jobs is suggested. Maintenance jobs are accordingly grouped and suggestions made for cutting costs. D. J. S.

39. Pressure relief devices. W. Samans. *Petrol. Process.*, 1955, **10** (6), 849–53.—Choosing one valve type over another—whether pop safety valve, safety valve, safety relief valve, or relief valve—depends upon the fluid being handled in the vessel on to which the valve is mounted. The modes of operation and the applications of each type of valve are discussed.
J. H.

40. Three problems in chemical reactor design. N. R. Amundson. *Ingenieur, 's Grav.*, 16.9.55, **67** (37), Ch 73–8.—3 problems in chemical reactor theory are discussed. The first 2 deal with the stability and sensitivity of the chemical reaction systems when they are perturbed from their steady state. Agitated continuous reactors may be unstable, and tubular reactors may have regions of sensitivity in which operation is difficult or impossible. Criteria for stability and sensitivity are developed and compared with rigorous solutions obtained on an analogue computer of the differential equations describing the process. The third problem involving the optimum design of a tubular reactor generalizes the work on simple reactions of previous investigators. New methods and computer solutions are required to determine the optimum temp profiles. 6 figs, 8 refs. (Author's abstract.)

DISTILLATION

41. Stabilization of separator liquid. J. M. Campbell. *Oil Gas J.*, 12.9.55, **54** (19), 120.—This is Pt 6 in a series and covers processing of separator liq by stabilization. 3 basic types of

stabilizers are in use, and include conventional reflux type, high-pressure, non-refluxed "cold-feed" stabilizers, and similar ones operated at lower pressure. Stabilizer design is discussed in relation to operation and cost of units. G. A. C.

42. Vacuum unit steps up cat feed quality. W. J. Burch. *Oil Gas J.*, 12.9.55, **54** (19), 104.—Cities Service Refining Co have installed a new modern 26,750 b.d. vacuum unit at the Lake Charles, Louisiana, refinery, to operate as an intermediate step between the topping units and the existing propane de-asphalting unit which was the first unit installed for production of cracking feed stock. G. A. C.

43. Low-temperature "dry" gas plant for Denver–Julesburg. N. W. Compston. *Oil Gas J.*, 19.9.55, **54** (20), 112.—The recently completed gas products plant of Continental Oil Co in Little Beaver field, Colorado, consumes only 2–5 brl of water/day, for jacket-water make-up and small miscellaneous use. G. A. C.

ABSORPTION AND ADSORPTION

44. Modern design—five basic improvements. E. J. Koehl and J. B. Taylor. *Oil Gas J.*, 29.8.55, **54** (17), 100.—The Fox gas-processing plant designed and constructed by Hudson Engineering Corpn for Signal Oil and Gas Co employs latent cooling of compressor engine jackets, hydraulic motor drive on engine jacket cooling fans, propane production as a side stream ‹ raw-off from de-ethanizer, extensive use of gas-engine drivers for pumps and fans, and specially designed cooling tower. Plant recovers 50% of inlet propane and essentially all of the heavier hydrocarbon, processing 35,000,000 cu. ft/24 hr. G. A. C.

CRACKING

45. Autothermic cracking of heavy petroleum oils in reactor having interchangeable internal walls. B. Blouri and H. Gault. *Chim. et Industr.*, 1955, **74**, 435–40.—Cracking (710°–870° C) by regulated oxidn of feed (gas oil, 100% paraffins, d_{15} 0·77, 212°–302° C; or light fuel oil) in presence of air in lab reactor (detailed sketch), pre-heat to 390° C. Reactor filled with kaolin; walls of quartz or Fe. With gas oil Fe lining gives higher yield of H_2 and more C, hence quartz is used for cracking of the heavier feed. Analyses are given of gas and liq products for both feeds, also tests on fuel oil using O_2-enriched air. Olefin content of issuing gas 14–33%, olefin ratio on N_2-free gas remains fairly steady; despite relatively low olefin yield, price aspect (80 frs/m³ gaseous olefins) is favourable due to low capital cost of plant and cheap feed stocks. Liq products (20°–345° C) from fuel oil are high in aromatics. V. B.

46. Kinetics of regeneration of powder catalysts. K. P. Lavrovskii and A. L. Rozental. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk*, 1955, (6), 140–8.—Tests on 3 alumino-silicate cat used for cracking of gas oil and one alumino-chrome cat used for aromatization of naphtha. Quartz apparatus (sketch), issuing gas analysed for O_2, CO_2, CO, tests at atm and higher pressure. Kinetic equations are derived, coke oxidn is first order reaction with respect to O_2, regeneration rate increases with pressure to extent that O_2 concn rises therewith. (*Cf.* Abs. **2881**, 1952.) V. B.

47. Fluidized coke tested in rotary kiln. R. M. Canforth and E. R. Lee. *Oil Gas J.*, 12.9.55, **54** (19), 137.—Full-scale tests with burning of fluid coke in firing of a rotary kiln by Kaiser Engineers are discussed. A run with ground coke indicated a performance almost equal to that with 100% gas flame. G. A. C.

HYDROGENATION

48. Contribution to the chemistry of coronene. L. Boente. *BrennstChemie*, 1955, **36** (13–14), 210–14.—Coronene is found in various products of cracking pressure hydrogenation of oils and of C_3-containing materials, *e.g.* coal, brown coal, tar pitch, petroleum dist, and cracking residues. Isolation and behaviour, especially limited cleavability conditioned by its structure, and its occurrence in the hydrogenation process resulting from this are discussed. Mode of origin and relation to the difficult decomp constituents of the hydrogenation products are discussed. In tech pressure hydrogenation coronene has a yellow-green phosphorescence and a deep-yellow colour due to an unidentified impurity. In hydrogenation of coronene with Ni cat several partially hydrogenated intermediate stages occur, with WS cat perhydrocoronene is obtained, phosphorescent, and forming a stable mol compound with coronene. Due to its difficult cleavability, high m.p., low solubility, strong absorbability on active materials, and its relatively easy sublimability, coronene differs from the other highly-condensed aromatics. These properties can cause coronene to be a disturbing factor in pressure hydrogenation. 10 literature refs. R. T.

POLYMERIZATION

49. Polymerization of ethylene and other olefins. R. Ziegler, E. Holzkamp, H. Breil, and H. Martin. *Chim. e Industr.*, 1955, **37** (11), 881–2.—The authors give a summary of their studies on the nature of the cat process and of the cat used in a new process for the production of polyethylene at atm pressure, and on the possibility of producing highly crystalline polymers having mol. wt. from a few thousands to several millions. The cat used for the polymerization of ethylene may be used for the copolymerization of ethylene with α-olefins. These cat have enabled C. Natta and co-workers to polymerize for the first time pure α-olefins, to give new types of polymers different from the others for the steric configuration of their macromolecules. (Authors' abstract.)

ALKYLATION

50. Improved H_2SO_4 alkylation process. A. R. Goldsby and D. H. Putney. *Oil Gas J.*, 19.9.55, **54** (20), 104.—The alkylation process unit which employs effluent refrigeration, of the Texas Co at Amarillo, Texas, is described. The unit has lower capital investment, decreased operating cost, increased yield, higher alkylate quality, and low acid consumption, and 6 months experience indicates that the alkylate shows octane appreciation when blended with cat reformate and cat cracked gasoline. A flow sheet is given. G. A. C.

CHEMICAL AND PHYSICAL REFINING

51. Desulphurization of gas oils by catalytic hydrogenation. W. C. van Zijll Langhout, G. J. F. Stijntjes, and H. I. Waterman. *J. Inst. Petrol.*, Aug. 1955, **41** (380), 263.—The paper discusses the significance of desulphurization in the petroleum industry, and then reviews some of the more important industrial hydrodesulphurization processes, including the "Autofining" and Shell "trickle" processes. A description is also given of desulphurization experiments on Middle East gas oils in the gas phase, using a Co–Mo–Al_2O_3 cat. 49 literature refs are included. U. M.

52. Derivative hydrocarbons. P. W. Sherwood. *Petrol. Engr*, 1955, **27** (7), C25.—These hydrocarbons are made by polymerization, alkylation, or dehydrogenation. This article discusses products of dehydrogenation process, examples being *n*-butene to butadiene and styrene production. *n*-Butene conversion is normally a 2-step process using a cat of the calcium nickel phosphate type, but a direct process by Houdry using a chromia–alumina cat and working on a heat-regenerative principle is in use. Ethyl benzene is directly dehydrogenated to styrene, in the vapour phase over a fixed-bed cat based on magnesium or iron oxide. The indirect synthesis of styrene through acetophenone and methyl phenyl carbinol is also described. J. B. S.

SPECIAL PROCESSES

53. Investigation of methane synthesis in plant having a pseudo-fluid catalyst layer. S. F. Gudkov and A. B. Chernuishev. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk*, 1955, (5), 154–6.—Experiments in lab reactor (sketch) using finely divided (40–200 μ) Ni cat. Feed gas 36% CO, 63·6% H_2, 0·4% N_2, temp 320°–370° C, space velocity 11,500–58,400 litres/litres cat/hr. Results showing composition (CO_2, CO, CH_4, H_2, H_2O, N_2) of issuing gas are tabulated; at higher space velocity and lower temp ratio CO_2/CH_4 was 0·07, with 14% CH_4. V. B.

54. First British plant manufacturing Epikote resins. Anon. *Petrol. Times*, 30.9.55, **59** (1517), 1011.—The Epikote resin and diphenyl propane plant processes at Stanlow belonging to the Shell Chemical Co are described, and uses, particularly in marine paints, reviewed. G. A. C.

55. Make butadiene directly from butane. Anon. *Chem. Engng*, 1955, **62** (9), 118.—Details are given of 2 single-step dehydrogenation processes employing the Houdry process. The process is outlined and some operating conditions given. D. J. S.

METERING AND CONTROL

56. Air pollution instrumentation. Anon. *Instr. Pract.*, 1955, **9**, 871–85.—Standard instruments commercially available to help combat problem of air pollution are illustrated and described. These comprise instruments for measuring % CO_2; % (CO + H_2) and CO_2; % O_2; S-containing gases such as SO_2, SO_3, and H_2S; smoke density; dust content; and also B.t.u. meters for district heating schemes. B. S. W.

PRODUCTS

CHEMISTRY AND PHYSICS

57. Information on the physicochemical principles of recovery and decomposition of phenol fractions from coal tar and brown coal-low-temperature-carbonization tar. E. Terres *et al. BrennstChemie*, 1955, **36** (15–16), 228–36.—Report III. Chromatographic separation of tar phenols. Suitability of various chromatographic separations for tar phenols is discussed. Phenols can be separated from contaminating resins and hydrocarbons, and phenols and phenolcarboxylic acids can be split into groups. A simple process permits detection of *m*- and *p*-oxybenzoic acid along with salicylic and the higher homologues. Aq-soln at 0° C are suitable for separating simple monovalent phenols. The good applicability of H_2O shows that paper chromatography does not depend in every case on a distribution between 2 liq phases. However, it plays an important part in many cases. H. Toepsch has supplemented W. Ruppert's investigations by measuring the RF-val of 38 phenols. Knowledge of these val—which lie between 0·80 and 0·92—was necessary for clarifying the composition of phenol fractions obtained by dist from tar, with the aid of the b.p. curves. A relation was obtained between the position of the substituent or substituents to the OH-groups and the RF-val. Within a homologous series *p*-substituted cpds are absorbed the strongest, *i.e.* they have a lower RF-val than the corresponding *o*-cpds; the *m*-cpd lies about midway between these val. Also with di- and tri-substituted cpds this relation could be confirmed. R. T.

58. Reactivity of coke with CO_2 in the temperature range 1000° to 1200° C. A. Dahme and H. J. Junker. *Brennst-Chemie*, 1955, **36** (13–14), 193–9.—The chem-physical reaction velocity const K—obtained by modifying the Koppers method for estimating coke reactivity—and accurate evaluation of the gas analyses, present a measure for coke reactivity with CO_2. This is independent of the apparatus const and gives the temp dependence of the reaction corresponding to Arrhenius' law. Therewith the reaction behaviour of fine-grained coke is described—in the temp range observed—by the reaction velocity const at 1100° C and the activation energy. Surface combustion phenomena observed on partially gasified cokes of 2 ytpes—special and industrial—are described and discussed. R. T.

59. Kinetic study of the mechanism of slow oxidation of gaseous acetaldehyde and propionaldehyde. A. Combe, M. Niclause, and M. Letort. *Rev. Inst. franç. Pétrole*, 1955, **10**, 786–804, 929–65.—New reaction oxidn schemes are obtained from the mechanism previously suggested (*cf.* Abs. **2035**, 1953) by adding 2 new processes for production of free radicals by hydroperoxide decomp are discussed. Experimental studies of gas phase oxidn of CH_3CHO and CH_3CH_2CHO confirm suggested mechanisms and enable a choice to be made between 3 proposed schemes. Slow thermal (<150° C) vapour phase oxidn of both aldehydes is similar. (Authors' summary.)

60. Chemical engineering fundamentals: general considerations in reactor design. I. T. E. Corrigan. *Chem. Engng*, 1955, **62** (9), 203.—An introduction to reactor design is given, dividing the problem into process design and mechanical design. The parts of a process are discussed, selection of reactors and a discussion of reaction systems are given. D. J. S.

61. The viscosity of liquid hydrocarbons. L. Grunberg. *J. Inst. Petrol.*, Aug. 1955, **41** (380), 249.—This paper sets out to show how complexity of mol structure and other factors can lead to deviations for liq hydrocarbons from the simple exponential equation $\eta \propto e^{\Delta E/RT}$ relating visc and temp. Changes in temp produce changes in the state of order and in the configuration of mol. The changes are studied by separating the free energy term into an energy factor and a configurational entropy; the atmospheric b.p. is chosen as the reference state for studying changes in configurational entropy. The configurational entropy is found to be positive for rigid hydrocarbon mol, while it is negative for more flexible mol. It is suggested that an equation containing 3 constants and requiring measurements at 3 temp may suffice for characterizing the visc–temp relationship of hydrocarbon oils. Discussion on the paper and 5 literature refs are included. U. M.

62. Synthesis of aldehydes at room temperature by reaction between olefins, dicobalt-octacarbonyl, and hydrogen. R. Pino, R. Ercoli, and F. Calderazzo. *Chim. e Industr.*, 1955, **37** (10), 782–6.—By reacting the olefins with dicobalt-octacarbonyl under high hydrogen pressure it is possible to achieve a stoichiometric synthesis of aldehydes. The reaction takes place smoothly at room temp following a well-defined stoichiometry, 2 mol of aldehydes per mol of dicobalt-octacarbonyl being produced. In the absence of the olefins, operating at room temp, under high hydrogen pressure (750 atm), the cobalt carbonyl hydride can be obtained from the dicobalt-octacarbonyl. The presence of the hydride appears to be necessary in order to carry out the stoichiometric synthesis of aldehydes. The stoichiometric and the cat syntheses of the aldehydes show some interesting analogies, particularly the partial pressure of carbon monoxide, which shows an unfavourable effect on the hydroformilation, and inhibits both the stoichiometric aldehydes synthesis and the cobalt carbonyl hydride synthesis. (Authors' abstract.)

ANALYSIS AND TESTING

63. Direct oxygen estimation. K. Drehkopf and B. Braukmann. *BrennstChemie*, 1955, **36** (13–14), 203–8.—Direct determination of O_2 in solids and liq is described. The apparatus illustrated is more automatic than Unterzaucher's prototype. Reverse washing is replaced by partition of the N_2 stream; one part forwards the decomp-gases, the other prevents air entering the apparatus. The reaction tube can remain open permanently during the analyses. Titrimetric estimation of I_2 as a measure of the O_2 cont of the substance is replaced by measuring the conductivity change of the NaOH produced by a quantity of CO_2 equiv to the O_2 cont. Results are recorded automatically. R. T.

64. Importance of graphic-statistical analysis for investigating mineral oils. H. I. Waterman. *BrennstChemie*, 1955, **36** (13–14), 199–203.—Pt 2. Relations between magnitudes susceptible to variations in structure are discussed with supporting charts. Graphic-statistical analysis is applied to hydrocarbon mixtures successfully. Insight into existing processes and development of new ones are purposed. 15 literature refs. R. T.

65. Analysis of gaseous mixtures with a new unit. K. H. Clough. *Petrol. Engr*, 1955, **27** (10), C26.—In the Fracton apparatus described, the analytical method depends on the selective adsorption and desorption of gases by charcoal and their subsequent identification by thermal conductivity. Any mixture of organic components that is a gas at 105° C presents a prospective application for this method. The complexity of the sample has no effect on the time required or the accuracy of the method. J. B. S.

66. Small-capacity equilibrium still. S. R. M. Ellis and J. M. Thwaites. *Chem. Proc. Engng*, 1955, **36**, 358–60.—Design and operation of a 40-cc equilibrium still capable of giving satisfactory vapour–liq equilibrium data are described. Tests using ethyl alcohol–benzene and *n*-propyl alcohol–water binary systems produced experimental results in close agreement with theoretical figures. B. S. W.

67. Spot chromatography of hydraulic mineral oils using fuller's earth. J. E. C. Stringer. *Nature, Lond.*, 1955, **176**, 81.—A thin film on glass of fuller's earth prepared as a slurry in trichloroethylene has been used for spot chromatography of mineral hydraulic oils, which are compared by examining the fluorescence of the rings formed by the constituents of the oils. H. C. E.

68. Rapid lamp method for total sulphur. W. R. Battles. *Petrol. Engr*, 1955, **27** (7), C41.—Details and dimensions of the lamp and ancillary equipment used in the micro-determination of sulphur in gasoline and dist are given. This is a development of apparatus described *ibid.*, 1953, **25**, 12, and 1954, **26**, 6. J. B. S.

69. Direct estimation of mineral content of coals. W. Radmacher and P. Mohrhauer. *BrennstChemie*, 1955, **36** (15–16), 236–9.—Minerals contained in coal tar are separated by treatment with HCl and HF under conditions which do not alter the C_2 in wt and composition. The assumed oxidative change of the C_2 is due to HCl addition. The mineral cont is given by wt loss in the acid treatment, with corrections for HCl absorbed, pyrites cont of the coal, and the incineration ash of the treated coal. The pyrites cont is calc from the Fe cont of the residual ash. This process is free from simplifying assumptions, *e.g.* regarding the water of hydration of the silicates and the mol. wt. of the carbonates. The relative simplicity is suitable for routine analyses. R. T.

70. Quantitative estimation of phenol in coal tar. A. Marx and L. Rappen. *BrennstChemie*, 1955, **36** (15–16), 225–8.—The process described in detail—controlled dist combined with set. pt. determination—permits phenol estimation in coal tar with max accuracy. It is suitable for scientific work, but not for routine industrial analysis. R. T.

71. Detection and determination of traces of polynuclear hydrocarbons in industrial effluents and sewage. III. Examination of some gasworks effluents. P. Wedgwood and R. L. Cooper. *Analyst*, 1955, **80**, 652–5. Separation ($CHCl_3$ extraction followed by chromatography) and identification (u.v. spectroscopy) of hydrocarbons from spent ammoniacal liquor and carburetted water-gas plant effluent are described. It is concluded that the latter may well prove to be the more important potential source of sewage pollution by gasworks effluents, particularly when high rates of oil gasification are practised. B. S. W.

ENGINE FUELS

72. Fuel gas systematism according to graphic-statistical methods. F. Schuster. *BrennstChemie*, 1955, **36** (13–14), 208–10.—Van Krevelen's quotient diagram, applied by him to solid fuels in a broad systematism, presents a wider development of the C–H–O-triangle and can be applied like this, also to fuel gases with the same conformity to law. The diagram is illustrated. R. T.

73. Research on synthetic liquid fuels by the U.S. Bureau of Mines. Anon. *Petrol. Times*, 16.9.55, **59** (1516), 967.—Progress in 1954 is reviewed, subjects dealt with include hydrogenation of coal, structure and the Fischer–Tropach synthesis, production of synthesis gas, and oil from oil shale. G. A. C.

74. When octane breaks 100—how will we measure knock? Anon. *Petrol. Process.*, 1955, **10** (6), 837–9.—A scale for expressing fuel anti-knock ratings above 100 octane which will be acceptable to both the petroleum and automotive industries was discussed at a meeting in Detroit on 26 April, sponsored by the Coordinating Research Council Joint Research Agency—of API and SAE. Both CRC and General Motors suggested methods based on the Army–Navy (AN) system of performance numbers for aviation gasoline adapted to automotive instead of aero engines. Another CRC suggestion was an extrapolation of the present scale above 100, using an equation containing the factors of *iso*-octane plus TEL and performance numbers for a conversion to octane No's. It is also intended to develop more indicative and precise anti-knock ratings, thus saving refiners $12 million p.a. J. H.

GAS OIL AND FUEL OIL

75. Ruston turbine heavy fuel tests. Anon. *Gas Oil Pwr*, 1955, **50**, 199, 212.—A test comprising 10 runs of 100 hr each was made on a Ruston 3CT gas turbine using fuel (3·5% S, 50 p.p.m. V, 26–62 p.p.m. Na; 300 p.p.m. total ash) to which was added a Mg cpd. After each run the turbine blading was water-washed *in situ*. The first 5 runs were made at a mean gas temp of 700° C (90% of full load) and during the next 5 runs the temp was varied between 650° and 750° C.

Examination of the unit after test showed no serious corrosion. *Ca* 90% of the deposit on the turbine stator blades could be washed away after each run, and near the end of test the turbine swallowing capacity was 97% of the original value. H. C. E.

76. Running diesel engines on cracked distillate. Anon. *Gas Oil Pwr*, 1955, **50**, 220.—For successful operation with cracked dist fuel the latter must: (1) have the correct spray and flow characteristics necessary for use in high pressure fuel injection systems; (2) have a C.N. high enough to ensure proper combustion; (3) not form gums during storage. In addition, the lub oil in the engine must be maintained in good condition.

It was found that the 3 requirements listed above could be met by using additives with the fuel. Recent improvements in lub oils, introduced to deal with the S present in diesel fuels, helped to solve the problems involved. H. C. E.

LUBRICANTS

77. Lubricating grease—the pattern of usage and supply today. E. G. Ellis. *Petroleum, Lond.*, 1955, **18** (9), 325.—Research into the physics and chemistry of rubbing solids has shown that solid lubricants are superior to those in the liq state. An account is given of the characteristics of modern lubricating greases and their applications in current engineering practice. J. B. S.

78. Lubricated friction conditions and lubrication improvement by chemical products. A. Roos. *Chim. et Industr.*, 1955, **74**, 441–7.—Fundamental conditions governing hydrodynamic, thin (non-molecular), and molecular film lubrication are discussed. Description (sketches) are given of Marcelin "friction-graphe," suitable for investigation of unctuosity and lubricant films of molecular size order (stratofilms). Lubricant action of MoS_2 and Li base greases is briefly considered. V. B.

79. Contact effect as a factor in oil oxidation in internal combustion engines. S. V. Ventsel. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk*, 1955, (7), 139–44.—Tests in disk friction machine (steel and Cu, oil temp *ca* 35° C, 20 hr) showed considerable oil oxidn (rise in acidity and asphaltenes content) and support hypothesis that localized friction (contact effect) is a major cause of oil deterioration. Addition of finely powdered wear products (metal particles) did not cause oil oxidn at moderate temp (lab tests at 80° C), although addition of such products to crankcase of experimental engine accelerated deterioration of oil therein. Comparative tests in I.C. engine operated normally and also motored from external source with springs inserted in cyl to simulate resistance showed in latter case (oil temp *ca* 30° C) appreciable oil oxidn, confirming importance of friction effects. V. B.

BITUMEN, ASPHALT, AND TAR

80. Bituminous materials, their processing and use mirrored in the newer German patent literature. H. Hoffmann. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (7), 232–3; **6** (8), 281.—Continued classification with specification details and drawings. R. T.

81. Important questions regarding treatment for bituminous covering and sealing material. A. W. Rick. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (7), 238–9.—Tech questions on cementing roofing paper are considered. Preparation of the cement, temp sensitivity, pasting on, and other methods of securing the paper, with relative advantages, are discussed. R. T.

82. Detection of phenols in bitumen by two-dimensional paper chromatography. M. R. Verma and R. Dass. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (8), 253–7.—For detecting and identifying phenols in bitumen a mixture of known quantities of C.P. grade phenols with various grades of bitumen is analysed by 2-dimensional chromatography. A spot of the mixture placed on one corner of a filter paper is eluted with C_5H_5OH in one direction, and extracted phenols are diazotized with sulphanilic acid. The bitumen spot, cut out from the filter paper, is eluted with M.E.K. at right angles to the original elution; bands characteristic of the phenols separate out and are identified by colour and position on the paper. Difficulty arises in identifying the colours in presence of *m*- or *o*-cresol. The aluminium cell employed is illustrated and results tabulated. 19 literature refs. R. T.

83. Problem of broken stone use in road foundation. T. Temme. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (8), 263–7.—Investigation shows that physical properties of superstructure and foundation influence pressure distribution in road subsoil. Orientation of coarse-grained, embedded stone exerts a supporting action on the whole stone mixture. The triaxial pressure test results permit qual prediction of the serviceability of different materials for protecting road foundations. Quan comparison relative to dynamic loading is possible when sufficient material is available. Viscous materials, *e.g.* asphalt–concrete behave differently—in relation to testing speed—from pure stone mixtures. The speed under short dynamic loading should be > under static loading. Economically, results of the investigation are of especial importance where high-grade materials are available at prices approaching those for competing lower grades. R. T.

84. School playground sealings with bitumen emulsion. W. Georgy. *Bitumen, Teere, Asphalte, Peche*, 1953, **6** (8), 268–73.—A profusely illustrated article on requirements of a safe, healthy playground. Various constructions with production details are tabulated. R. T.

85. Properties of joint fillers with especial regard to testing their resistance to the effect of motor fuel. H. E. Müller. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (7), 240–1.—Properties of joint fillers, not given in DIN 1996, are insensitivity to effects of fuels and lub, heat-resistance, and difficult inflammability. An American test depends on pen and increase or decrease in wt of the filler exposed to kerosine. An approx valuation is obtained from the stability of the filler on coated sheet iron immersed in kerosine. R. T.

86. Why is continuous asphalt best? Yun-Nan Fan. *Petrol. Process.*, 1955, **10** (6), 862–4.—A continuous unit with 3 vertical converters, installed in the Chinese Petroleum Corpn's Kaohsing refinery at Taiwan, China, requires lower equipment and maintenance costs due to the elimination of converter heating facilities. The blowing time has been halved due to greater equipment efficiency, resulting in increased throughputs. Greater air-blowing efficiency has reduced air requirements as much as 87% for making 220 soft. pt. product from 100 soft. pt. feed stock—air requirements for batch blowing were around 6000 cu. ft/p.s.i. in the continuous unit. Better quality asphalt is obtained—being free from carbons entering the asphalt from "stalactites" that form in the horizontal batch still during the splashing caused by air blowing, and possesses greater ease of control and operation on a continuous basis than on the batch basis, which required repeated filling, heating, and discharging operations. J. H.

87. Reaction of heavy motor truck traffic on road conditions. T. Temme. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (7), 221–3.—The greater part of the German roads have inadequate foundations, especially in wet and frosty weather. Modern and future requirements relative to construction, repair, and maintenance costs are considered. Californian practice is discussed in detail. R. T.

SPECIAL HYDROCARBON PRODUCTS

88. Effect of chelating agents on heterogeneous catalysis. A. Dobry. *Nature, Lond.*, 1955, **176**, 266.—The rate of oxygen absorption by transformer oil was compared with that of transformer oil containing 0·25% of chelating agent, both in the presence and the absence of solid Cu. The chelating agents comprised αα′-dipyridyl, disalicylal ethylenediamine, and 3 "Versenes" (oil-soluble alkyl amino-acetic acids). The oxidn was followed by observing the pressure decrease at 120° C.

It is found that, whereas in the absence of Cu there is an induction period of several days before rapid oxidn commences, in the presence of Cu, and particularly with αα′-dipyridyl, rapid oxidn quickly sets in. The rate of oxidn is greatly increased, both with and without Cu, by the chelating agents. H. C. E.

DERIVED CHEMICAL PRODUCTS

89. Petrochemicals—a growing national gasoline outlet. L. O. Crockett and R. C. Widgery. *Petrol. Engr*, 1955, **27** (10), C15.—Petrochemical projects permit upgrading of end products, a higher return on investment, a reduction of storage problems, and an increase in the proportion of flat-load sales.

The principal petrochemical products and the uses to which they can be put are described. J. B. S.

90. Making chemicals by oxidation. E. T. Powers. *Oil Gas J.*, 29.8.55, **54** (17), 74.—Trends in processes of oxidn of methane and ethane, propane and butane are discussed, for production of oxygenated chemicals an increase in overall yield of hydrocarbons converted to chemicals and more selective oxidn processes are indicated.

3 major reaction variables in hydrocarbon oxidn, ratio of reactants, temp and pressure are discussed, and techniques of oxidn reviewed. G. A. C.

91. Natural gas to acrylonitrile. Anon. *Oil Gas J.*, 5.9.55, **54** (18), 110.—American Cyanamid Co's Fortier plant process at Avondale, Louisiana, to make acrylonitrile from natural gas involves partial combustion of the gas to make acetylene, reaction of ammonia, more natural gas and air to produce HCN, and reaction of acetylene and HCN to make acrylonitrile. I.r. analysers are extensively used. G. A. C.

92. Air-pollution control in Houston area. J. C. Reidel. *Oil Gas J.*, 5.9.55, **54** (18), 107.—Sinclair Refining Co have installed a sulphur-recovery plant with a capacity of 30 tons/day of commercial sulphur at Houston as part of a $3,500,000 atmosphere-pollution control programme in the refinery. A description of the recovery process is given. G. A. C.

COAL, SHALE, AND PEAT

93. Identification of a carcinogenic compound in coal tar. E. Kennaway. *Brit. med. J.*, 1955, (ii), 749–52.—Historical account of work leading to isolation and identification of 3 : 4-benzpyrene. V. B.

94. International Conference on Coal Science. Anon. *Nature, Lond.*, 1955, **176**, 103–5.—Report of a conference held at Heerlen, May 1955, at which the following themes were discussed: genesis, constitution, and properties of coal, and carbonization and coal structure.

In the first section the formation and chemical constitution of lignin were discussed, and the conversion of lignin into coal. Humic acids are probably intermediate in coal formation, but humic acid content does not necessarily decrease with increasing maturity of the coal. Humic acids produced by lab oxidn of coal were oxidized with permanganate, hydrogen peroxide, or ozone, and fractions of the product were separated. No individual cpds could be detected. Fractionation of material obtained by hydrogenation of coal at high temp and pressure yielded information on the mean number of fused aromatic rings per mol of product. I.r. techniques have been used to show the presence of phenolic hydroxyl groups in low rank coals and to estimate the proportion of aliphatic hydrocarbon groups.

In the second section the plastic softening of coal during heating, the porous structure of coal, and the mechanical properties of coke were discussed. Papers were also given on microscopic investigations on coal, and the reactivity of coke to CO_2 at high temp. H. C. E.

MISCELLANEOUS PRODUCTS

95. The adsorption of surface-active agents at solid–liquid interfaces. J. L. Moillet. *J. Oil Col. Chem. Ass.*, 1955, **38** (8), 463.—Aspects considered are: the possibility of adsorption with reversed orientation, this is compared with amphipatic adsorption and the possible formation of pseudo-adsorbed layers; interfacial tension at solid–liq interfaces and the effect on this of adsorption of surface-active materials; and the applications of surface-active agents at solid–liq interfaces. D. K.

CORROSION

96. Corrosion in the petroleum industry. Pt. III. F. H. Garner and A. R. Hale. *Corrosion Tech.*, 1955, **2** (7), 218.—Various chemicals are used in the refining of petroleum products and in such processes as alkylation and isomerization. Some of these chemicals are corrosive, particularly in the presence of water or at elevated temp, and protection is obtained by the use of special alloys in those sections of the plant liable to attack.

Monel metal and other nickel alloys are extensively used in such processes as the regeneration of hydrofluoric acid in alkylation, the reboiling of alkali soln in hypochlorite sweetening, for furfural solvent extraction, phenol extraction, dewaxing using chlorinated solvents, and in the Girbitol processes for the removal of hydrogen sulphide, sulphur dioxide, and carbon dioxide from cracked gases by means of aq ethanolamine or a mixture of ethanolamine and diethylene glycol as absorbent.

Stainless or Staybrite steels are used in such processes as aluminium chloride liq phase isomerization, for which Hastelloy B is a good protection, in the furfural recovery plant for temp of 400° F and upwards, where 18–8 stainless steels are recommended, while in the drying column of the Edeleanu plant using sulphur dioxide, Staybrite F.M.B. stainless steel is found beneficial.

For the storage of corrosive crude oils and intermediate products containing hydrogen sulphide and other sulphides, guniting with a lining of crushed brick and cement is now in general use. These linings are expected to give protection for *ca* 20 years, but this period has not yet been reached in practice. W. W. G.

97. Vinyl coatings cover the refinery. C. G. Munger. *Petrol. Engr*, 1955, **27** (7), C7.—Refinery equipment is subject to corrosion not only from weather but also from refinery fumes, steam, high humidities, and often salt air. Large numbers of vinyl resins are available with varying properties, ranging from high moisture vapour transfer or low, alkali resistant or reactive, etc. Types and methods of coating are discussed, especially preparation of surface and application of bonding layers. J. B. S.

98. Processing plants control corrosion. B. W. Bradley. *Petrol. Engr*, 1955, **27** (10), C58.—A brief description is given of the fluid characteristics and internal corrosion damage observed in flow lines and processing plants in different fields. Treatment depends on the characteristics of the field. Iron removal rates and Audigauge metal thickness surveys are effective methods for evaluating process vessel corrosion and determining the condition of process equipment after corrosion has occurred. J. B. S.

99. Valves for corrosive fluids. E. G. Holmberg. *Corrosion*, 1955, **11** (9), 406–14t.—Methods are given whereby valves for control of corrosive fluids may be selected. Case histories of valve failures from corrosion are given and analysed.

Detailed consideration is given to the design of valves and their component parts, with recommendations concerning approved designs suitable for certain classes of service. W. G. R.

100. Countermeasures for control of internal corrosion of a tanker ship. C. P. Dillon. *Corrosion*, 1955, **11** (9), 393–405t.—Various anti-corrosion measures are considered, including coatings, inhibition of cargo and ballast, use of inhibited fresh and sea water, changes in Butterworthing schedule, cathodic protection with and without concurrent inhibition. Both lab and field tests are reported.

It is tentatively suggested that the best method for the ship under consideration is concurrent inhibition of cargo with an oil-soluble inhibitor and treatment of empty tanks with a soluble-oil inhibited salt water wash to give a reduction of corrosion up to 75%. W. G. R.

ENGINES AND AUTOMOTIVE EQUIPMENT

101. Engine design as affected by fuels and lubricants. Pt I. The spark-ignition engine. C. A. Beard and D. Downs. *Inst. Petrol. Rev.*, 1955, **9** (99), 53.—Increase in spark-ignition engine power and efficiency has been due to simultaneous progress in the fields of metallurgy, mechanical engineering, and chemistry. In other words, advances in fuel quality and in engine design have proceeded side by side. The discovery that " knock " was associated with fuel quality as well as with engine design led to the development of measuring techniques using engines of variable compression; and hence to the more effective guidance of the petroleum refineries. The design of the combustion chamber and of the spark-ignition engine itself are described, and then the authors proceed to discuss the use of TEL as a gasoline additive. Although only small quantities of this additive are employed, it may give rise to trouble due to deposit formation unless precautionary steps are taken. In practice, TEL is added in association with organic halides, so that a lot of the lead is removed in the exhaust gases in the form of the more volatile halides. This matter is developed further, and this part of the article concludes with a discussion of mixture distribution. R. H.

102. Engine design as affected by fuels and lubricants. Pt II. The compression-ignition engine and aspects of lubricating oil performance. C. A. Beard and D. Downs. *Inst. Petrol. Rev.*, 1955, **9** (100), 87.—In contrast with the I.C. engine, progress with the diesel or compression-ignition engine has been dependent less on improvement in fuel quality than on improvement in combustion chambers and fuel injection equipment. The high swirl and direct injection types of combustion chamber are described in detail, and mention made of other types popular outside the U.K., such as the pre-combustion chambers and air-cell chamber types. The mechanical design of the diesel engine is discussed with particular emphasis on the piston. Ignition quality of the fuel expressed in terms of the cetane No. is considered, it being pointed out that a cetane No. of 45–50 gives satisfactory operation in most high-speed diesel engines today, while diesel fuels currently marketed in the U.K. often have cetane Nos. within the 55–58 range. Difficulties arising in the form of corrosion due to the sulphur content of diesel fuels are mentioned. The post-war marine diesel engine has tended to use heavier diesel fuels, which are, of course, less expensive. Attention is then turned to lubrication problems and to the production of lub oils which have a high V.I., achieved by direct refinery process or by the use of additives. Lub oils, of course, are subject to the incorporation of additives for many other purposes, *e.g.* anti-oxidant, detergent, and anti-wear additives. R. H.

103. Use of radioactive isotopes for assessing effect of dusty air on wear of tractor engines. A. I. Nisnevich and S. A. Shchurov. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk*, 1955, (7), 149–50.—50-h.p. tractor engine was fitted with piston rings incorporating radio-active Zn inserts, wear was checked by activity of sump oil after a 4-hr trial. For dust ($d = 2{\cdot}35$) additions to intake air of 0·0025–0·02 g/m³ wear increases linearly with amount of dust. Dust size 0–90 μ; tests on effect of particle size showed max wear to be caused by 10–20-μ particles. Decrease below 10 μ caused sharp drop in wear, increase above 20 μ only slight drop. V. B.

SAFETY PRECAUTIONS

104. British fire research—1945. Anon. *Petroleum, Lond.*, 1955, **18** (9), 329.—Investigations have been continued into the mechanism of flame propagation in gases and the flammability limits of gases, including a theoretical investigation into the role of radicals in flame initiation and propagation. Suppression of fire is dealt with under headings of water, foam, and vaporizing liq extinguishing agents, and special fire hazards, *e.g.* removal of " static " from petrol, are considered. Fire fighting equipment and technique is also briefly mentioned, with particular reference to aircraft crash fires. J. B. S.

MISCELLANEOUS

105. The Italian petroleum industry—aspects and problems. G. Cozzi. *Inst. Petrol. Rev.*, 1955, **9** (102), 125.—This well-tabulated article emphasizes the change in the pattern of the Italian petroleum industry from 1926 to 1938, viz. a steady increase in the import of crude oil for conversion to finished products, and a corresponding decrease in the quantities of finished products imported. This trend continued after the war, with the result that by 1950 Italy had become an exporter of finished products. The new refineries erected in Italy since 1945, largely supported by foreign capital, represent a noteworthy achievement. The achievement is illustrated by the fact that while in 1948 only 2,350,000 tons of crude oil were processed, the corresponding figure in 1953 was over 12 million tons. Over 5 million tons of finished products were exported in 1953, a quantity which is bound to be greater in the future because of the lack of demand on the home market. R. H.

106. Canada builds refineries while keeping pace in octane race. G. Weber. *Oil Gas J.*, 15.8.55, **54** (15), 148.—Canadian refiners have to build new refining capacity at a rate fast enough to meet the expanding demand for petroleum products; and at the same time compete in octanes and quality of all their products generally. It is estimated that cat reforming will take place in practically every refinery in Canada by 1960, with a capacity of 150,000 b.d. by that date. New capacity has been designed to process new western crudes. Tables show projected capacity of Canadian refinery and estimated vehicle population and gasoline requirements. G. A. C.

107. Petrochemical plant survey. Anon. *Oil Gas J.*, 5.9.55, **54** (18), 89.—6 tables show list of petrochemical plants in U.S.A. and Canada, giving plants, locations, raw materials, and finished products (both organic and inorganic chemicals). Also a list of butadiene and copolymer plants recently sold to private industry by the Government. G. A. C.

108. Fuel research in 1954. Anon. *Petrol. Times*, 30.9.55, **59** (1517), 1005.—The report of the Fuel Research Board for 1954 is reviewed. Matters dealt with include coal syntheses, flow properties of residual oils, breaking oil–sea water emulsions, thermal decomposition of paraffin hydrocarbons, and atmospheric pollution. G. A. C.

109. Research Council of Alberta report for 1954. Anon. *Nature, Lond.*, 1955, **176**, 495.—Sections on petroleum and natural gas describe studies of trace metals (including Mg) and of S in crude oils. Settling characteristics of solid particles in emulsions of water in heavy fuels showed that the water retards the settling of the particles. Heavy oil fractions have special merits as briquette binders, and attempts have been made to separate the S compounds from these fractions. Research on natural gas includes studies in the formation of carbon black. H. C. E.

110. Critical observations on production of high-pressure hollow bodies in multiple-part construction for high-pressure synthesis. J. Schierenbeck. *BrennstChemie*, 1955, **36** (15–16), 239–44.—Types of multiple-part constructions for high-

pressure hollow bodies are illustrated and discussed critically. For bulk production only the forging, smith, and winding processes come into question. The last-named is superior for high pressures. R. T.

111. Present sulphur supplies and requirements in the United Kingdom and trends in supply and demand. W. A. M. Edwards. *J. Inst. Fuel*, Sept. 1955, **28** (176), 422.—Uses of sulphur and sulphur-containing raw materials are reviewed. Annual production and consumption figures for sulphur and compounds are tabulated. Recent developments and probable future trends in supply of and demand for sulphur are summarized. D. K.

112. Smoke abatement in practice. G. E. Foxwell. *J. Inst. Fuel*, Sept. 1955, **28** (176), 451.—Lecture to the Scottish Section of the Institute of Fuel at Glasgow read 1 April 1955. Aspects considered are: smoke abatement by industrial concerns, railways, problems of domestic fuel supply, fuel used for domestic purposes, domestic heating appliances, cost of smokeless fuel, quality of coke, coal supplies, organization of smokeless or smoke-controlled zones. Examples are given of the financial effect of the Government Loan Scheme. 6 literature refs. D. K.

113. Why automatic data-handling systems? A. H. Freilich. *Oil Gas J.*, 26.9.55, **54** (21), 252.—Automatic data logging results in speed, accuracy, and safety, and contributes to overall plant efficiency by permitting better utilization of man power in non-routine tasks. G. A. C.

BOOK REVIEW

Basic Lubrication Practice. Allen F. Brewer. New York: Reinhold Publishing Corpn; London: Chapman and Hall, 1955. Pp. xiv × 286. £2 14*s*.

Considering the importance of lubrication, textbooks on the subject are remarkably few. Allen F. Brewer's book is a welcome addition and appears at an opportune time in the U.K. in view of the current and growing interest in the activities of lubrication engineers. It is addressed primarily to lubrication and maintenance engineers and aims at giving practical, on-the-job information which will lead to dependable operation of plant and maximum production of goods at minimum cost of maintenance. It is not without interest, however, to the petroleum technologist and the student making a first approach to the subject.

The basic principles of lubrication, and their application to specific types of machinery, are admirably and lucidly presented over a wide range of equipment. The rôles of speed, load, temperature, and contaminants are discussed. It is refreshing to find an author who stresses that factors such as over-lubrication, careless handling of bearings, and contamination can be responsible for failures or poor performance, which are all too often attributed to the lubricant. Useful practical guidance is given regarding the proper maintenance of bearings, engines, and equipment generally. Special applications, such as chains, wire ropes, flexible couplings, and seals are not forgotten. Detailed consideration is also given to bearing materials and bearing design.

Separate chapters are devoted to the storage and handling and the reconditioning of lubricants. Mention is made of reconditioning methods which will remove soluble contaminants, and in the next paragraph (p. 265) reference is made to systems handling large quantities of premium grade additive oil. The only warning that methods which remove soluble matter should not be used with additive oils, is given somewhat obscurely in the table on p. 270.

Additives have long ceased to be regarded with suspicion as an undesirable means of hiding the deficiencies of a poor oil. The author deals rather too briefly with the functions of additives. He rightly stresses that laboratory tests for their evaluation should be regarded as only good preliminary sorting tests, and insists on performance in an engine as the ultimate criterion.

For many years the oil industry and various learned societies have encouraged the use of absolute units for viscosity determined in precision instruments in place of flow times derived from some sort of pot with a hole in the bottom. Methods for the determination of kinematic viscosity are prominent in both ASTM and IP methods and are now almost universally used in petroleum laboratories. It is therefore somewhat misleading to say on p. 22 that "the American Society for Testing Materials favours the Saybolt Universal Viscosimeter for determining viscosity" and "another method of measuring viscosity . . . is the kinematic procedure." Such expressions as "decrease in viscosity or body" and "lower viscosity or lighter bodied lubricants" should also be discouraged.

The references given at the end of each chapter bear witness to the volume of specialized literature published by equipment and lubricant suppliers in the U.S.A. It is left to the dust cover to call attention to several standard works on lubrication also published by the Reinhold Publishing Corporation. Textual reference to these and other important, relevant publications would have been helpful, especially to the student.

"Basic Lubrication Practice" is a most useful addition to the library of all interested in lubrication, whether from the theoretical or practical point of view. W. P.

ADDITIONS TO THE LIBRARY

Analytical Chemistry: The Working Tools. 2 vols. Ed. C. R. N. Strouts, J. H. Gilfillan, and H. N. Wilson. Oxford: Clarendon Press, 1955. Pp. 1067. £5 5*s*. net (U.K. only).

In 1928 Imperial Chemical Industries Ltd formed their Analytical Chemists' Committee, one of its primary objects being to co-ordinate analytical procedure throughout the Company. More recently it was decided to make available to others the results of research likely to be useful to industry generally. This has been done in these two volumes, which, in their 28 chapters, appear to cover every aspect of analytical chemistry from manipulation to chromatography and the application of statistical methods.

Fuels and Fuel Systems. Tulsa, Okla: Natural Gasoline Association of America, 1955. Pp. 108.

A compilation of papers by technologists of Phillips Petroleum Co on the problem of vapour lock in fuel systems. Aspects of fuel characteristics, ambient temperature and pressure, and fuel systems are discussed, the CRC 1946 data and the NGAA–WPRA Pawhuska data are re-examined, and a method for evaluation of vapour lock tendencies and fuel system characteristics of passenger cars is given.

References to Scientific Literature on Fire. Pt VII, 1953. Miss E. M. Shakeshaft and Mrs. B. F. W. Rogowski. Boreham Wood: Joint Fire Research Organization, 1955. Pp. 122.

A bibliography of nearly 1300 items published in 1953 on the subject of fire hazards and fire precautions, including work on combustion, etc. There is a number of references to oil fires and an excellent subject index is provided. An author index is given.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

114. Look back—then look forward. E. A. Koester. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1191–5.—This was the presidential address given at the 40th annual meeting of the American Association of Petroleum Geologists in New York in March 1955. It was delivered before the joint session of the Association, the Society of Economic Paleontologists and Mineralogists, and the Society of Exploration Geophysicists. The author emphasized that when the first meeting was held in Norman, Oklahoma, in 1916 the U.S. was producing less than a million barrels of oil per day. Today more than 200 million ft of section in 52,000 wells are measured by the bit, the microscope, and the electrical log every year. These rocks receive much more detailed study in the field, the office, and the lab than is given the normal outcrop in the field. This is one example of the contribution to the science of geology by the petroleum industry.

The author reported a growth in membership of *ca* 1000 during the previous year. E. N. T.

115. Hazard, probabilities and petroleum. L. Wenger. *Bull. Ass. franç. Tech. Pétrole*, May 1955, (111), 193–240.—Some views on hazard and probability are first presented, and this is followed by the discussion of data on wells drilled in various areas in respect of degree of success and basis for location. Figures are given on the sizes of U.S. discoveries, and on geophysical activity, drilling, expenditure on different activities, and production in France and her colonies.

It is concluded, in exploring a new region, that after an adequate preparatory programme it is necessary to have sufficient capital when drilling is undertaken to drill enough wells to have a fair chance of discovering any oil there is. Many enterprises have failed by not doing enough, and leaving to others the opportunity of making a discovery. On the other hand, having assessed the situation on the basis of

geological and geophysical data, there is a practical limit to what can be considered as useful exploratory drilling.
G. D. H.

116. Contribution on the recognition of source rocks. Y. Khalifeh and M. Louis. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 340–4.—It is thought that the organic material which has given rise to oil leaves residues in the sediment, and analyses of these will permit the recognition of oil source rocks. If oil generation requires reducing conditions it follows that the organic matter will not have been oxidized. The mother rocks should be richer in hydrogen than the coaly deposits, but the direct determination of hydrogen is difficult. Separation of the organic matter by dissolving the mineral matter in HF is difficult. The ratio of the reducing power to the carbon content should be a measure of the state of reduction of the sediment, and it seems that 0·8 is the minimum value for source rocks. In obtaining the reducing power of the organic matter in a sediment, allowance must be made for oxygen consumption by other substances, especially pyrites. (The results of a series of analyses are given.) Not all the organic matter in the source rock may be favourable for oil formation, and this may affect the critical ratio.

In practice, hydrocarbons were extracted from the samples using chloroform. The samples should have 4–5% organic matter (inert diluent being added where needed, *e.g.* kaolin). 600 g was put with 5 cc of 0·3% $KMnO_4$ in a closed Erlenmeyer flask, heated at 60° C. A series of samples was used and additional amounts of $KMnO_4$ added to the remaining flasks as pairs were used for analysis, until over 50% of the organic matter was oxidized. Plots of the reducing power–carbon ratio against amount of carbon oxidized differ in form according to whether source rock characteristics are or are not present. The form may reveal different components with different susceptibilities to oxidn.
G. D. H.

117. On the distribution of fractures in an oil pay. A. E. Scheidegger. *Canad. Min. metall. Bull.*, 1955, **48**, 671–3.—The possibilities of deriving pertinent information about fractures in an oil pay from data obtained by core analysis are investigated. It is shown that it is possible to obtain an estimate of the fractured area per unit volume of the pay, and that the size of the fractures can be estimated if their shape is known. A suggestion of a routine procedure for the analysis of fractures is given. (Author's abstract.)

118. European bibliography of recent progress in sedimentology. A. Vatan. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 335–6.—The scope of sedimentology is wider than that of sedimentary petrography, and sedimentology is not only a prophet of the past but also a study of current events. Although the present conditions may be transient and special, the same chemical and physical laws will control events as in the past. A bibliography of recent European papers on sedimentology is of value in the search for oil, and this bibliography appears as a supplement to the May issue of the *Revue*.
G. D. H.

119. Practical value of some microfossils. H. E. Thalmann. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1196–201.—This formed the presidential address delivered at the 29th annual meeting of the Society of Economic Paleontologists and Mineralogists in New York in March 1955. The author pointed out that today we are celebrating the centennial of micropaleontology, although d'Orbigny as far back as 1840 had already stressed the stratigraphic value of one of the groups of " larger " microfossils, the foraminifera. However, in this group of microfossils great progress has been made only since the first world war, and the practical value of the still smaller microfossils has been recognized only since the termination of the second world war.

Micropaleontology is today undergoing a steady metamorphosis as more and more attention is paid to, and more and more monographs and papers deal with, the long-forgotten, neglected, or overlooked micro-organisms, such as the diatoms, the oögonia, the spores and pollens, and other groups of minute creatures such as the coccolithophorids.
E. N. T.

120. East-side Williston still seeks answer. F. J. Gardner. *Oil Gas J.*, 1.8.55, **54** (13), 139.—2 wells recently drilled on the E. flank of the Williston basin in Bottineau County, N. Dakota, have found small amounts of oil, which is hopeful for further exploration in this part of the basin. 3 types of trap may be expected: erosional wedge-outs, porosity traps due to facies changes or reefs, and unconformity traps. Lensing out of Dakota and Lakota sands has been proved, but so far they have been found water-bearing. Facies changes in the Palæozoics are important targets, and there may be Silurian reefs similar to those at surface in Manitoba.

The E. half of the Williston basin is an area of thin sediments, facies change, and rapid truncation, almost devoid of structure, and the search for oil is mainly a stratigraphic problem.
C. A. F.

121. Rate of deposition shown by relative abundance of foraminifera. D. G. Moore. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1594–600.—Estimates of the percentage by volume of foraminifera in cores from 7 deep borings in San Antonio Bay, Texas, were made, and curves of these percentages *v.* depth were drawn to 55 ft. This was part of a programme of deep borings undertaken in the Rockport, Texas, area by the Scripps Institution of Oceanography under the sponsorship of API Project 51. Upon completion of preliminary estimates on 68 samples from various depths in 6 cores it was noted that the abundance of foraminifera in each of the cores seemed to show similar fluctuations with depth. It was assumed that production of foraminifera was at a constant rate and therefore that the rate of total sediment deposition was inversely proportional to the percentage of foraminifera at any depth. Based on this assumption, depositional rates were computed at depth intervals of 2½ ft and checked by Carbon-14 dating. The curve of rate of deposition *v.* time drawn from these calculations shows a large variation in rate, with a max of 4·7 ft per century at −6900 years, decreasing to a minimum rate of 0·2 ft per century from −3100 to −4100 years.
E. N. T.

122. Geologic framework of Gulf Coastal Plain of Texas. J. A. Waters, P. W. McFarland, and J. W. Lea. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1821–50.—The Gulf Coast Plain has more than 30,000 ft of sedimentary rocks. Properly subdividing this mass of sediments into formations and correlating each unit from one region to another presents many problems. The facies changes encountered have emphasized the need for sedimentary studies to aid in the solution of these problems. The authors present structural, isopach, and sand percentage maps illustrating: (1) the present structure and position of selected horizons from the Jurassic through the Miocene; (2) the thickness of these sediments; and (3) the ratio of sand to shale and regional facies changes. E. N. T.

123. Central Texas coast sedimentation: characteristics of sedimentary environment, recent history, and diagenesis. F. P. Shepard and D. G. Moore. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1463–593.—The purpose of API Project 51 has been to establish criteria from the study of recent shallow-water marine and estuarine sediments which can be used as an aid in identifying the environment of deposition of ancient sediments. One of the 2 areas chosen to initiate this work is described in the present report. This area, around Rockport, Texas, 30 miles NE. of Corpus Christi, includes a group of shallow connected bays separated from the open Gulf by exceptionally wide barrier islands and a broad, relatively smooth continental shelf. By using a team of sedimentationists, biologists, and chemists, a considerable number of differences have been determined in these 3 major environments and in subdivisions of each. Influences such as salinity, waves and currents, depth of water, and source material are indicated as the primary controls of the sediment

types. In addition to the assemblages of organisms, statistical studies of the constituents of the coarse fraction have been particularly helpful in characterizing the environments.
E. N. T.

124. Record well testing. Anon. *Oil Gas J.*, 15.8.55, **54** (15), 108.—A well near the Lake Washington field, Louisiana, has been drilled to 19,752 ft, and 4 possible gas condensate pays below 16,500 ft were indicated; one of these has been tested and found non-productive. Salt water was found at 19,035 ft. If higher zones are unproductive the well will be drilling to 22,500 ft, becoming the world's deepest. C. A. F.

125. Rank wildcat hits. Anon. *Oil Gas J.*, 1.8.55, **54** (13), 66.—A wildcat, 15 miles W. of the Cut Bank field, at Morning Gun, Montana, has proved Mississippian wet gas production. On test the well recovered 6000 M.c.f/day and 250 b.d. dist from a 40-ft zone at *ca* 9000 ft.

The discovery is in the Disturbed Belt, a southerly extension of the Canadian Foothills belt. Little previous drilling has been carried out in the area, although seeps have been known for some time.

The discovery has shown a Mississippian wet-gas trend extending *ca* 350 miles from NW. Alberta through Turner Valley and Jumping Pound into Montana. C. A. F.

126. Paleogeologic map at base of Woodford and Hunton isopachous map of Oklahoma. R. S. Tarr. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1851–8.—The author discusses the extent of pre-Woodford–post-Hunton folding and erosion in Oklahoma. Certain structural features are shown, and a relationship between these features and "Wilcox" oil and gas accumulation or lack of accumulation is pointed out.
E. N. T.

127. Facies of Middle and Upper Ordovician rocks of Iowa. A. F. Agnew. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1703–52.—Recent subsurface and outcrop studies of the Middle and Upper Ordovician rocks in Iowa show that facies changes are of considerable importance in the interpretation of the geologic history and in the correlation of the strata, which are oil-bearing in adjoining states. The generalized lithologic character of these rocks is given, and facies maps and isopachous maps show that a number of stratigraphic zones can now be placed in their correct relation to each other.
E. N. T.

128. Pennsylvanian rocks of Eastern Interior basin. H. R. Wanless. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1753–820.—The Eastern Interior basin of the U.S.A. has produced *ca* 5 billion (U.S.) tons of coal and 325 million brl of Pennsylvanian oil. Pennsylvanian rocks underlie *ca* 53,000 sq miles in Illinois, Indiana, and W. Kentucky, with small outliers in Missouri and Iowa, attaining max thicknesses of *ca* 2500 ft in SE. Illinois. Cyclic sedimentation is very well displayed with at least 25 alternations of coal, marine limestone, shale, sandstone, and underclay. E. N. T.

129. World's northernmost well is gasser. Anon. *Oil Gas J.*, 8.8.55, **54** (14), 70.—A well drilled in the U.S. Petroleum Reserve No. 4, near Point Barrow, Alaska, has been completed as a gas producer at 2600 ft. This is near the Gubik gas field, which is on an E.–W.-trending anticline with a Cretaceous reservoir. Rocks in the area are reported to be similar to those in the Rocky Mountains. C. A. F.

130. Eastern Canada's six potential oil provinces. W. A. Roliff. *Oil Gas J.*, 15.8.55, **54** (15), 114.—6 sedimentary basins in E. Canada offer prospects for finding production. These are the Hudson Bay Lowlands, SW. Ontario, the St Lawrence Lowlands, Anticosti region, the Gaspé Peninsula, and the Maritimes region.

In the Hudson Bay Lowlands, where Ordovician to Devonian and a little Lower Cretaceous are developed, prominent anticlines occur, but no indications of oil and gas have been found in water wells.

31 oilfields and *ca* 44 gas fields have been discovered in SW. Ontario since 1858. Pays are mainly in the Devonian Dundee and in the Silurian Salina Guelph limestones and dolomites. Maps and cross-sections of a few of the fields are included.

The St Lawrence Lowlands are underlain by Cambrian and Ordovician rocks, and a number of wells in the region have had gas and oil showings but no commercial production. Suitable trap structures are reported. No wells have been drilled on Anticosti island, where beds are Ordovician and Silurian; reefs are present. Only reconnaissance mapping has been carried out so far.

In the Gaspé Peninsula 72 wells have been drilled, many of which had shows in the Devonian. A few wells produced a few b.d. Prospective rocks in the Maritimes region are Mississippian and Pennsylvanian, and a field was found at Stony Creek in 1909 with Mississippian Horton pay.

There has been increasing interest in exploration in E. Canada in recent years, SW. Ontario receiving the most attention. C. A. F.

131. *In situ* origin of McMurray oil of Northeastern Alberta and its relevance to general problem of origin of oil. C. S. Corbett. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1601–49.—Of the many theories of origin that have been proposed for the McMurray oil in the basal Lower Cretaceous McMurray formation of NE. Alberta, the 2 which currently have any substantial following among petroleum geologists attribute the oil, on the one hand, to organic material deposited *in situ* as the source, and on the other hand, to oil from the underlying Paleozoic (predominantly Devonian) formations which moved into its present position either subsequently to the deposition of the McMurray sediments or in the main during the time of their deposition. It is suggested that humic acids derived from land plants were probably the major source material of the McMurray oil, and a number of reasons are given in support of this idea, while the probable steps in the transformation to oil of this organic matter entering the sea in the river waters are traced.

It is clear that these oil deposits do not fit into concepts of a conventional oilfield, and this accumulation does not seem to have been governed by structural or stratigraphic trap conditions. It is suggested that various features of the McMurray deposit give reason to regard it as an oilfield in a state of arrested development. E. N. T.

132. Foothills have posed a challenge for 70 years. L. G. Millward. *Oil Gas J.*, 15.8.55, **54** (15), 130.—The history of exploration and discoveries in the Rocky Mountain Foothills area of Alberta is described. 5 fields have been found: Turner Valley, Jumping Pound, Brazeau, Pincher Creek, and Savanna Creek.

Compared with footage drilled, discovery rate in the area has been low, and costs are high. Interest has increased following the discovery of Savanna Creek in 1954.

There are a number of potential pay zones, and several wildcats have found indications in beds ranging from Late Cretaceous to Cambrian. N. of the Athabaska River there are many structures where the Mississippian and Devonian prospective pays are relatively shallow. C. A. F.

133. Recent development of the search for oil in Africa. M. Delavesne. *Bull. Ass. franç. Tech. Pétrole*, July 1955, (112), 365–80.—The policy in deciding to speed up work in Africa is that it is better to tackle several regions where the problems can easily be delimited rather than to devote all the effort to finding all the accumulations, possibly small and well hidden, in the Aquitaine or Paris basins. Africa has large sedimentary basins, and if they contain oil it may well be in large amounts. Various organizations have been created to undertake the work in Africa, and in 1954 expenditure was 62 milliards of francs, with a somewhat larger sum allocated for 1955. Permits for work in Africa cover 1,455,000 km^2. Aerial photography is being widely used, and work completed or in progress involves some 330,000 km^2. Surface geological work supplementing the aerial studies in 1954–55 involved the Tindouf basin and other areas in Algeria, the Taoudeni basin

in the Sudan, the basin between Adrar des Iforas and L'Air in the Sudan and Niger area, and 2 basins in the Chad region. Geophysical work has been executed in a number of areas: gravimetry in Algeria, Tunis, Senegal, Ivory Coast, and Gabon; seismic refraction in Algeria and Senegal, with work planned in Madagascar and the Cameroons; magnetometry in Tunis and Madagascar, with work elsewhere in progress or planned. In some areas reflection work is very difficult or impossible. Telluric currents have been used in Gabon, Madagascar, and the Sahara, and electrical surveys in Madagascar and Senegal. Detailed work is proceeding in some areas. Core drilling has been done with rigs capable of 1000–1500 m. Water well data have been studied.

Wells in the Algerian Sahara have indicated the presence of hydrocarbons. At Djebel Thara there is oil in a tight Lower Devonian sandstone. In the Cameroons numerous oil shows have been met, but so far always in small lenses. Gas at Bomone was sufficient for development if local users could be found. Gas dissolved in brine was found in Senegal, and good oil indications in French Equatorial Africa. Much stratigraphic knowledge has been acquired by drilling, not all of it favourable. In some areas the sediments are thin or extensively intruded. Some substantial gas flows have been met.

While use is made of foreign technicians where needed, it is desirable for French technicians and finance to be used extensively in these operations in French territory.

G. D. H.

134. Evolution of exploratory activity in Africa. R. Valat. *Bull. Ass. franç. Tech. Pétrole*, May 1955, (111), 243–73.—Oil exploration in Gabon, Madagascar, and the Cameroons raises many problems which are not present in France. It has been found that a substantial base with adequate equipment and personnel is an eventual economy by increasing the efficiency of the operations. Means of access to the site of operations present different problems in the different countries. The difficulties are not great in Madagascar, although long detours may sometimes be necessary. Roads are practically non-existent in Gabon, but there is a well-developed series of rivers, and these have been used to get access to the interior. Seasonal rains may, however, cause wide variations in level and flow. Some roads are also needed, their function being for access to a well site, or to permit geophysical activity. Ease of movement depended on the season. Radio communication, and such operations as dropping material by parachute have been of great help. Light planes have also proved of value for some purposes. Field camp equipment must combine lightness and mobility with sufficient facilities to avoid undue hold-ups and to support a group of Europeans and Africans at a point remote from a civilized centre.

Over a period there has been a considerable improvement in drilling speed and moving, with a reduction in delays, ill-health, and personnel.

Climate introduces some personnel problems. High temp and humidity may cause some discomfort after a time. Various maladies, grave and trivial, have to be combated, as well as some troubles which are largely mental. Mosquitoes may be more difficult to combat in temporary than in permanent camps. It may be better to work for a long time at a low rate than intensively for a short period. A phase of acclimatization may be needed by newly-arrived Europeans. A considerable turnover of personnel prevents some features of experience being used to the best advantage.

Various methods have been used for selecting European personnel, but a period of 6 months on the job seems the best guide to suitability. The aim has been to build up a stable group of Africans, although there are still problems with largely seasonal operations. Accommodation should be better than the natives provide for themselves. Shops for the Africans are a help, while alcoholism and hygiene must be actively considered.

G. D. H.

135. Oil at Parentis. M. S. Scheer. *Bull. Ass. franç. Tech. Pétrole*, July 1955, (112), 349–62.—The Parentis discovery is the fruit of much patient labour. Oil and asphalt indications have long been known in SW. France. A thick cover of sediments in the N. and centre of the Aquitaine basin precluded satisfactory use of the geophysical techniques available some years ago. In 1939 gas was discovered at Saint-Marcet. After the war there was renewed activity, mainly in the south. In 1949 Lacq was discovered.

The Aquitaine basin has 2 different parts. In the N. against the ancient massifs are fringes of sediment of which the age becomes less towards the centre of the basin; to the S. the beds are more or less folded. In the centre the thick cover of recent sediments masks the deep geology. Water well logs suggested the presence of folds, and this was confirmed geophysically. Parentis is a buried structure. The Cretaceous is 1600 m deep, with the reservoir rock at 2000 m, covered by a thick marl series.

Gravimetry revealed a series of anomalies, some of which were detailed seismically, although not without solving many problems. The first well was located on the Mano structure in March 1953, because the Parentis data were not available. The hole was abandoned dry at 2750 m. Traces of oil were found in the Jurassic. The Parentis well was completed in April 1954. Impregnated limestone was met at *ca* 2250 m, a core showing fractured dolomite, while a drill stem test at 2254–2264 m recovered 3 m^3 of oil in 4 minutes.

The Parentis fold runs E.–W., with the S. flank steep. The upper part of the reservoir is Lower Cretaceous; the lower part may be Jurassic. The reservoir may be 400 m thick. The oil, gravity 0·86, has 0·5% sulphur and 24% of gasoline. Wells are 1200 m apart. Drilling time is 75–90 days. 7 producers have been completed. Reservoir pressure is 225·7 kg/cm^2 at −2200 m. In May 1955 7 wells averaged 1700 m^3 oil/day.

13 km E. of Parentis a new discovery was made in May at Mothes, oil being found in the Lower Cretaceous at *ca* 2405 m. The well gave 60 m^3/hr, the oil being 0·92 gravity.

G. D. H.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

136. 25 years of geophysics in wells. C. Rosoff. *Bull. Ass. franç. Tech. Pétrole*, May 1955, (111), 275–310.—The first commercial electric log was run 25 years ago after much experimentation. In 1953 there were 5000 employees using 500 sets of equipment. Not only has there been expansion in activity, but also new techniques have been developed.

The various techniques are discussed under the headings: methods for geological information—identification of rock type, correlation, dip measurement; methods for studying reservoirs with a view to getting estimates of the porosity and fluid content; caliper and deviation surveys, and determination of points of lost circulation; perforating, side-wall coring, temp measurements. The various electrode systems are described with an indication of their main uses and the preferred well conditions. Focusing devices, micro-logging, neutron and γ-ray logs, and induction logs are similarly mentioned.

G. D. H.

137. Geochemistry of subterranean waters: application to oilfield waters. H. Schoeller. *Rev. Inst. franç. Pétrole*, 1955, **10** (7), 671–719.—The occurrence of sulphate, carbonate, nitrate, nitrite, phosphate, Na, K, ammonium, Li, Mg, Ca, Sr, Ba, Mn, Fe, and B in subterranean waters is described. There is discussion of sulphate reduction, the Mg–Ca, and Na–K ratios, base-exchange effects, and radioactivity in oil and oilfield waters. Possible sources of some of the ions are considered.

G. D. H.

138. Today's methods of gravity interpretation. S. I. Hammer. *Oil Gas J.*, 18.7.55, **54** (11), 144.—Recent developments in techniques for gravity and magnetic interpretation are briefly outlined, and a definite trend towards more quantitative evaluation is indicated. The uses and limitations of the residual gravity map, the second-derivative technique, and the "continuation" interpretation are noted.

Electronic methods of computation have been developed, and efforts have been made to construct a bore hole gravimeter. 8 refs. C. A. F.

139. Correlating geological and geophysical data. D. C. Skeels. *Oil Gas J.*, 8.8.55, **54** (14), 156.—Ways in which geological and geophysical data can be correlated are outlined, and 3 points are emphasized. First, not all geophysical anomalies are related to structures, and significant anomalies must be distinguished from the non-significant. Secondly, the physical properties of the rocks, such as density and velocity, must be determined where possible, and finally the need is stressed for a good background of geological knowledge and imagination.

It is suggested that there are not enough of those trained in both geology and geophysics and that the industry is over-specialized in this field. C. A. F.

140. Future of geophysics. P. L. Lyons. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1202–13.—This paper formed the presidential address given at the 25th annual meeting of the Society of Exploration Geophysicists, in New York in March 1955.

This year marks the 25th anniversary of the Society of Exploration Geophysicists and the 25th year, approximately, of geophysics as an important industry. Although there are now 4450 members of the Society, which forms an all-time record, it is important to note that the year 1955 marks a continued decline in exploration for oil in the U.S.A. and in the world, as judged from the employment of seismograph parties. It is suggested that this decline indicates that in the U.S.A. an upper limit of action has been passed within the framework of exploration practices as they have existed. It is probable that application of improved instruments, techniques, and interpretations to geologic and stratigraphic problems will result in a new phase of sustained exploration with successes going to those with the most complete information and the best ideas. A changing geophysics will occupy an important place in the world petroleum economy, with at least 450 billion (U.S.) brl of oil yet to be found. E. N. T.

DRILLING

141. High-strength granular sealing material increases efficiency of primary cementing and squeeze cementing. C. A. Einarsen. *J. Petrol. Tech.*, 1955, **7** (8), 15–18.—The addition of 1–4 lb of high-strength granular material (graded walnut shells) to each sack of cement has been found beneficial in some 80 field tests by permitting high-column cementing operations in areas where high fill-ups cannot normally be obtained because of lost circulation. In 60 squeeze-cementing tests the number of cementing stages to shut off undesirable liq was reduced by adding 4–8 lb of the same granular material to each sack of the last 50% of the vol of cement slurry. The walnut shells do not reduce the strength of the set cement as much as does expanded mineral matter, and do not reduce the density so markedly. Data are given on the cement properties, and on the results of cementing operations in which these additives have been used. G. D. H.

142. Method for neutron derived porosity determination for thin beds. J. M. Edwards and A. L. Simpson. *J. Petrol. Tech.*, 1955, **7** (8), AIMME Tech. Paper No. 4101, 132–6.—In a semi-logarithmic plot of core-determined porosity against deflexion on the neutron log it was noted that the values for beds under 10 ft thick lay well above or below the other data. However, a correction factor has been derived which placed the points on or near the general curve. The conversion of the apparent radio-activity level (R_a) to the true radio-activity level (R_t) is by means of the relationship :

$$R_t/R_a = \frac{L/D}{\log_e \frac{e^{L/D} \times e^{T/D}}{e^{L/D} + e^{T/D} - 1}}$$

where L is the length of the detecting system, T the bed thickness, and D the drag. The drag is the product of the line speed (ft/sec) and the time constant (min). R_t is the level of radio-activity which would have been recorded if the detector had remained at a given depth for an infinitely long time.

The use of the scintillometer in borehole surveys has made it possible to measure the bed thickness with a high degree of accuracy. The top and bottom of a bed are marked by the position at which the recording pen begins to travel to a new level of radio-activity. G. D. H.

PRODUCTION

143. Analysis of reservoir performance k_g/k_o curves and a laboratory k_g/k_o curve measured on a core sample. T. D. Mueller, J. E. Warren, and W. J. West. *J. Petrol. Tech.*, 1955, **7** (8), AIMME Tech. Paper No. 4102, 128–31.—Performance curves for a reservoir of 800 ft dia and 100 ft thick with a 9⅞-inch well bore were calculated for initial rates of 100 b.d. and 1000 b.d., assuming the reservoir initially to be at the bubble point of 5000 p.s.i. The calculations were made with an I.B.M. 701 computer, and the K_g/K_o ratio was obtained at different gas saturations. The results were compared with the lab curve of the hypothetical reservoir, and it was found that the results for the lower field rate agreed most closely with the lab curve, especially at low gas saturations. The reason for non-agreement is the assumption of uniform pressure and saturation throughout the reservoir in the standard method of calculation. Even when the lab curve, which governs flow in the reservoir, is smooth, the performance curves have distinct humps, which are associated with transient behaviour in the reservoir and with changes in production programme. G. D. H.

144. Metastable equilibrium in the dew point determination of natural gases in the hydrate region. R. Kobayashi and D. L. Katz. *J. Petrol. Tech.*, 1955, **7** (8), 51–2.—The dew point of natural gas in equilibrium with gas hydrates has been reported to be lower than that for natural gas in equilibrium with water. Lowering of 13°–15° F has been reported. An explanation is offered for this phenomenon, and this involves the introduction of a metastable dew-point curve. The location of this curve is limited by thermodynamic considerations. A quantitative temp-composition diagram of the methane–water system at 900 p.s.i., is given. G. D. H.

145. Elements of fluid mechanics in porous media. Pt II. A. Houpeurt. *Rev. Inst. franç. Pétrole*, 1955, **10** (7), 730–50.—After dealing with certain aspects of Fourier series the problem of flow when the system is originally under equilibrium at P, and then has the pressure at the outflow face reduced suddenly to P_f, is presented. Curves giving the pressure distribution with time are derived, it being assumed that the distal pressure of P_g is maintained. Some variants of this type of problem are given.

Secondly, the case is examined in which the flux is zero at a finite distance. The pressure build-up on closing in after a period of flow is investigated. G. D. H.

146. Effect of relative permeability ratio, oil gravity, and solution gas–oil ratio on the primary recovery from a depletion type reservoir. J. J. Arps and T. G. Roberts. *J. Petrol. Tech.*, 1955, **7** (8), AIMME Tech. Paper No. 4103, 120–7.—Saturation-pressure history curves have been calculated for a series of different values of k_g/k_o for sandstones and limestones, and for different values of the API gravity and dissolved gas–oil ratio. The oil gravities were 5°, 15°, 30°, and 50°, and soln gas–oil ratios were 60, 200, 600, 1000, and 2000 cu. ft/brl, variably associated with the oils. Abandonment was taken to be at 10% of the initial pressure, the crude was assumed to be at the bubble point, and it was also assumed that there was no free gas cap, no water influx, no gravity drainage, and no gas or water injection. Connate water was 25% for sandstones and 15% for limestones. Producing rate and well spacing were disregarded, and a number of other assumptions was made. The max, average, and mini-

mum curves for each rock type are used to give plots of recovery in brl/acre-ft/% porosity against oil gravity. Recoveries improve at the higher oil gravities, and the results are compared with actual recoveries estimated by the API committee on well-spacing. G. D. H.

147. Quantitative interpretations of electric logs : theoretical bases. R. Dadone. *Rev. Inst. franç. Pétrole*, 1955, **10** (7), 720–9.—In the quantitative interpretations of electric logs a number of fundamental factors or relationships are involved : formation factor, resistivity index, spontaneous potential, the invaded zone and filter cake, and porosity. Fundamental formulæ are presented and discussed, and families of curves using these formulæ are given. The curves relate temp and resistivity for various concn ; formation factor, porosity and cementation factor ; saturation and resistivity index ; self-potential ; water and mud filtrate resistivities ; resistivity of mud filtrate, mud cake, and mud. G. D. H.

148. Log interpretation problem in low resistivity sands. H. A. Blum and J. L. Martin. *J. Petrol. Tech.*, 1955, **7** (8), 10–14.—Various recent papers have attributed low resistivities on electric logs of producing horizons to conductive ion layers connected with clays in the sands. It is now suggested that variations in interstitial water saturation may contribute to the low resistivities, and these variations may or may not be associated with the shale contact.

The problem has been investigated by means of samples from the Mustang Island field of Nueces County, Texas. The apparent formation factors decreased with increase in water resistivity, which is a feature typical of shaly sand core material. Interstitial water saturations were calculated for various conditions by different methods.

Hydrocarbon saturations were calculated by several different methods, and the results were compared with the known or expected fluid production. Where hydrocarbon zones are known to exist the de Witte and Poupon *et al* methods seem best. In exploratory wells the success of these methods in distinguishing hydrocarbon from water sands may depend on the resistivity assumed for the invaded zone. G. D. H.

149. Increase of oil yield from partially exhausted deposits by high-pressure gas injection. S. L. Zaks. *Izvest. Akad. Nauk SSSR, Otdel. Tekh. Nauk*, 1955, (9), 3–13.

150. Movement of gas-containing crude in system well-sand. V. A. Arkhangel'skii. *Izvest. Akad. Nauk SSSR, Otdel. Tekh. Nauk*, 1955, (9), 14–36.

151. Canal field gas injection project. C. J. Pings and W. Tempelaar-Lietz. *J. Petrol. Tech.*, 1955, **7** (8), 25–31.—A composite relationship governing the phase and volumetric behaviour of the hydrocarbons in the Canal field of the San Joaquin Valley, California, has been derived from p–v–t data on 5 samples. The pressure data have also been analysed, and found to include uncertainty in the averages due to trying to make the measurements represent too large areas of the reservoir. The oil in place was calculated by material balance to be $74 \pm 15 \times 10^6$ brl, which agrees moderately with 87×10^6 brl computed from core data. Water influx is believed to be of secondary importance in developing the field, the radius of the aquifer being calculated as 1·75 the radius of the field. Gas injection does not seem to have formed a gas cap, but 8×10^6 brl of oil is estimated to have moved down-structure between 1943 and 1947 (full-scale gas injection began in 1943). Previously 4×10^6 brl of oil had moved up-structure. There may have been considerable gas blow-through. It is thought that lifting costs have been reduced by the pressure maintenance. G. D. H.

OILFIELD DEVELOPMENT

152. How to get maximum recovery from a dry-gas field. D. H. Stormont. *Oil Gas J.*, 1.8.55, **54** (13), 80.—Producing methods and geology of the Wild Goose dry gas field in Sacramento Valley, California, are outlined. The field was discovered in 1951 and 8 producing wells have been completed on a dome structure. There are 11 separate producing sands in the Cretaceous, and the deepest pays are being depleted first. Over 950 ft of section contains sands which are gas-bearing in zones from 5 to 100 ft thick. Porosities range from 33 to 35%, and average permeabilities vary from 48 to 2500 mD. The sands are at 3000–4000 ft with initial reservoir pressures of 1200–1500 p.s.i. The gas contains ca 20% nitrogen. The field has been unitized, and in order to deplete the lowest zones progressively withdrawal rates have been calc for every well in each zone, and wells are equipped to produce the vol required automatically in response to pipeline pressures. C. A. F.

153. New Williston pay ? Anon. *Oil Gas J.*, 25.7.55, **54** (12), 142.—1 Beauchamp in the Newburg area of the Williston basin, 18 miles S. of the Canadian border, on test flowed oil and water from the Triassic Spearfish at 3403–3411 ft. This is the first Spearfish production to be found in the basin, but the formation is extensively developed in NW. Nebraska and the Dakota–Montana areas.

The basin now produces from the Ordovician, Silurian, Devonian, Mississippian (main producer), Pennsylvanian, Trias, Jurassic, and Cretaceous. C. A. F.

154. Firms tackle tar sands. Anon. *Oil Gas J.*, 8.8.55, **54** (14), 72.—The Athabaska tar sands, hitherto not exploited because no economical method of extraction has been found, are to be developed by a recently tested process in which the extracting unit consists of a series of centrifuges which separate the oil and sand in stages. It is claimed that this process frees 90% of the oil and that it can be produced at a price which is competitive with crude oil.

The tar sands extend for over 100 miles along the Athabaska River and its tributaries in NE. Alberta. Oil in place is estimated at 100–300 billion brl. C. A. F.

155. Developments in Mexico in 1953 and 1954. E. J. Guzman and F. Mina U. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1214–30.—During 1953 and 1954, 356 and 293 wells respectively were drilled in search for oil and gas in Mexico. 78% of these were successful, resulting in the discovery of 27 new oil and/or gas fields, 56 new pools, and 33 extensions to previously known production. A major new oil province was brought into production, and new fields along the SE. continuation of the Golden Lane have substantially contributed to increasing the country's reserves. E. N. T.

156. Petroleum developments in South America and Caribbean Area in 1954. W. L. Effinger. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1231–77.—New records were again set for crude oil production in every principal oil-producing country of S. America, as well as Trinidad, during 1954. The total increase in yearly petroleum production amounted to 53,037,891 brl or 7%, compared with a decrease of 10,058,108 brl or 1·3% in the yearly production in 1953 over the preceding year. The largest relative increases were in Bolivia and Chile. Peru and Venezuela reversed the 1953 downward drop in their production. Tables are given presenting a summary of the annual crude oil production in brl in S. America and Trinidad by countries during the past 3 years. E. N. T.

157. Petroleum developments in Middle East and adjacent countries in 1954. W. E. Heater. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1362–84.—Petroleum production in the Middle East countries in 1954 totalled 998,804,700 brl, a figure which is partly estimated for Iran. This was an all-time record, exceeding the daily average production for the preceding year by 291,070 b.d. Production in India, Pakistan, and Burma totalled 5,733,000 brl. 2 new fields were discovered in 1954, Rumaila in SE. Iraq and Nahorkatiya in NE. India, and a discovery of oil was made at Jambur, which is located SSE. of the Kirkuk field in Iraq.

Geological and/or geophysical exploration was energetically carried out in many countries of the Middle East area during the year. E. N. T.

158. Petroleum developments in Far East in 1954. G. F. Kaufmann. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1385–402.—Political uncertainty continued to be an important factor in the slow development of the petroleum resources in the Far Eastern area, but in spite of this the total crude oil production of the Far East has apparently been increased by approx 7 million brl during 1954. Fairly large gains have been shown for Indonesia, Netherlands New Guinea, and probably for China. E. N. T.

159. Petroleum developments in Africa in 1954. H. D. Hedberg. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1320–61.—Petroleum production in Africa declined to 15,241,492 brl for 1954 as compared with 17,970,916 brl in 1953. This decrease was largely due to the decline of the Asl field in Egypt. Exploration activity in Africa continued to increase in 1954, and important oil or gas discoveries were made in Algeria, Egypt, French Morocco, and Nigeria. 86 exploratory wells and 69 development wells were drilled in the continent during the year, and exploratory drilling was 5·6% successful and development drilling was 58% successful. E. N. T.

160. Petroleum developments in Europe in 1954. R. E. King. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39**, 1278–319.—Oil production in W. Europe, including Yugoslavia, rose to 31,932,585 brl in 1954, an increase of 20%. This annual production corresponds with an average daily rate of 87,486 brl.

Production of countries within the Russian orbit is estimated at 1,315,000 b.d., but the relative increase in W. Europe was twice that in the Russian zones and 2¼ times that of the world as a whole. However, it was still only 0·7% of the total world production in 1954.

The outstanding development of the year was the discovery of the Parentis field in SW. France, which is the largest field yet found in France and possibly the largest discovered to date in W. Europe. E. N. T.

161. Oil in England. Anon. *Brit. Petrol. Equipm. News*, 1955, **4** (5), 45–7.—A short account of the search for oil is given and mention made that the geological formation does not promise large reservoirs of crude. Typical rock strata to be penetrated in drilling a well are included, and details of some drilling equipment used in the post-war period described. Geophysical surveys were extensively employed over wide areas in the search, but to date the average production is only 50,000 tons p.a., an amount useful economically but not in commercial quantity. E. A. G. H.

TRANSPORT AND STORAGE

162. Plastic foam checks evaporation losses. E. G. Ellerbrake. *Oil Gas J.*, 10.10.55, **54** (23), 248.—A report is given on 2 years' experience by Standard Oil Co (Ohio) of use of microballoon layer on the surface of crude oil in cone-roof storage tanks. Method has proved highly effective in the reduction of evaporation losses. G. A. C.

163. Cargo oil tank heating system. Anon. *Engineer, Lond.*, 1955, **200**, 343.—Established practice of using steel tubes with shrunk-on cast iron gilled sleeves for boiler economizers is now extended by E. Green and Son, of Wakefield, to steam-heated coils for cargo oil tanks. Cast iron in contact with high sulphur oils at metal temp in 220°–250° F range is more resistant to corrosion than mild steel, but strength of mild steel system is retained. To prevent waterlogging of coils with condensate, steam is fed into a parallel system of coils, each fitted with drain pot and exhaust riser. Detailed drawing and photographs. A. C.

164. Hydraulics for pipeliners. Pt IX. C. B. Lester. *Pipe Line News*, 1955, **27** (4), 35–41.—Bernoulli's equation is derived for incompressible fluids and applied to pipeline problems. The hydraulic gradient and hydraulic centre are dealt with in relation to the location of pumping stations. B. A. F.

165. Four techniques insure a better pipeline. R. G. Deering. *Oil Gas J.*, 17.10.55, **54** (24), 118.—Unusual practices are described in the 140-mile, 22-inch gas pipeline being laid by Colorado Interstate Gas Co. A strong light-wall pipe is being used, with extra deep ditch. Casing will be vented from the bottom. Coating is carried out with great care, and a high percentage of welds are to be inspected by X-rays. G. A. C.

166. See 11,432 miles of oil products lines in 1955–6. Anon. *Pipe Line News*, 1955, **27** (4), 42–4.—Details of the construction plans for 1955–56 are given in detail for a number of companies. It is estimated that 11,432 miles of oil and petroleum products line will be completed with dia ranging from 4 to 26 inches. B. A. F.

167. Constructing a section of super-highway pipeline. E. L. Pais. *Pipe Line News*, 1955, **27** (4), 29–34.—The installation of 78 miles of 20- and 24-inch natural gas pipeline completed the construction of the 1200-mile pipeline from the Gulf Coast of Louisiana to a central point in Pennsylvania. An outstanding feature of the construction was the extensive use of explosives for clearing the right of way and blasting hard sandstone in some areas of the trench line. B. A. F.

168. Gulf Interstate gas line has many novel features. E. Sterrett. *Pipe Line News*, 1955, **27** (5), 24–34.—1160 miles of line connects the gas-producing Gulf Coast with the industrial east, where the Columbia Gas System Inc has an integrated distribution system. The line consists of 845 miles of 30-inch main pipe and 315 miles of gathering system, with pipe of varying dia. The present throughput of 375 M.c.f/day is maintained by 5 booster stations each having 4 2000-h.p. compressors. It is proposed to increase the throughput to 465 M.c.f/day by the addition of 5 more booster stations and by increasing the power available at existing stations. The 5 stations are similar in layout and have semi-automatic control which requires supervision by one operator per shift. Application has been made for a fully automatic system. The line is patrolled regularly from the air, and emergency repair kits have been devised in case of leakage of the pipe. B. A. F.

169. Mississippi bridge largest in world. Anon. *Pipe Line News*, 1955, **27** (6), 29–31.—The recently completed bridge carries twin 30-inch pipes across the 2150-ft bridge span. Pipe design allows for a max operating pressure of 858 p.s.i., and allowance was made for: (1) wind forces up to 40 lb/sq. ft. (2) ice loads of 107 lb/ft. B. A. F.

170. P. G. and E's super inch line. P. E. Reynolds. *Pipe Line News*, 1955, **27** (5), 36–9.—The 787 miles of 34-inch pipeline operated by the Pacific Gas and Electric Co is capable of delivering 700 M.c.f/day of gas and utilizes a total compressor capacity of 66,860 h.p. The line was designed on a max working stress of 72% of the yield strength. Medium manganese steel plate was rolled and welded into cyl by a submerged arc process, then cold expanded to correct size. Steel was saved by "tapering" the pipe, which was reduced from ½-inch wall thickness on the upstream and to $\frac{7}{16}$ inch on the downstream end of the line. Operation of the line has been satisfactory, and the pipe has withstood the effects of an earthquake. Steps were taken to relieve the resultant stresses in the pipe. B. A. F.

171. Tower maintenance. W. M. Taylor. *Pipe Line News*, 1955, **27** (4), 48–9.—Regular maintenance of communication towers should include the re-tensioning of the supporting guy wires and the re-aligning of the tower. It is advisable to have a regular painting schedule and regular renewal of all safety lights. B. A. F.

172. Pipeline cost estimating. J. B. Elam. *Oil Gas J.*, 10.10.55, **54** (23), 139.—The article shows how to organize data for speed and accuracy in estimating pipeline construction and operating costs. 6 charts are given. G. A. C.

173. How to determine pipeline flow efficiency. J. L. Duke. *Oil Gas J.*, 10.10.55, **54** (23), 213.—Texas Gas Transmission Corpn's method involves ammonia injection for measuring flow vol and compares in accuracy to use of large-vol flow meters and is simpler. New data are presented on variation of pipeline efficiency with flow rate. G. A. C.

174. Pipeline automation. A. R. Heidebrecht and F. S. Jones. *Oil Gas J.*, 10.10.55, **54** (23), 157.—The overall team effort in automation is discussed. It is concluded that success or failure of automation is more dependent on acceptance by management and operating groups than on technical ability of the engineers. G. A. C.

175. On-stream cleaning of gas pipelines. P. L. Hughes. *Oil Gas J.*, 3.10.55, **54** (22), 116.—Experience is given of Texas Eastern Transmission Corpn with on-stream cleaning of converted liq lines, lines requiring removal of much fluid, and new lines. Efficient use of scrapers and trains of scrapers is discussed. G. A. C.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

176. West German refining—a 600% + increase in capacity. Anon. *Petrol. Process.*, 1955, **10** (9), 1368–71.—Total petroleum processing capacity in W. Germany for 1955 is estimated at *ca* 244,000 b.d., more than a 6-fold increase within the last 7 years. Pre-war German processing capacity was only 47,000 b.d., and half of this was destroyed during the second world war. 6 synthetic fuel and 4 coal hydrogenation plants were also damaged or dismantled. Before the second world war, over 75% of Germany's demand for petroleum products was imported from abroad in the form of finished products. Over $238 million has been invested in the expanding W. German petroleum processing industry. Today there are 22 refineries and 3 hydrogenation plants having 12 cracking units, 3 reforming units, and 3 hydrogenation units. J. H.

177. Process design of tubular heaters. L. A. Mekler. *Oil Gas J.*, 3.10.55, **54** (22), 108.—The time–temp effect and conversion efficiency are studied in the design of tubular heaters. The effect of reaction temp on yield of ethylene and propylene in cracking of ethane and propane is exemplified. Typical process heaters, film cracking, and process heat requirements are discussed. Tables are given, including a summary of trial-and-error calculations for visbreaking, evaluation of time–temp effect on a range of temp, and radiant heat-absorption rate in single-row banks. G. A. C.

178. Why tall smokestacks fail to end air-pollution woes in Houston area. F. L. Resen. *Oil Gas J.*, 3.10.55, **54** (22), 139.—Experience has shown that stacks must be used in conjunction with scrubbers, filters, and cyclones. Wind velocity and land topography are very important factors, temp inversion being the main trouble. G. A. C.

179. What El Paso Natural learned about gas-turbine maintenance. J. C. Arnold. *Oil Gas J.*, 31.10.55, **54** (26), 86.—Details are given of maintenance of 10 gas-turbine stations, involving 28 gas turbines, which have more electrical control than reciprocating movers. Maintenance involves fixed periodic inspection of generators, relays, switch gear, batteries, voltage regulators, and pump motors. G. A. C.

180. Here's a model waste-disposal system. C. O. Anderson and K. C. Gardner. *Oil Gas J.*, 31.10.55, **54** (26), 75.—The system is operated by the Rock Island Refining Corpn, Indianapolis. The refinery capacity is 14,000 b.d. The treating-water effluent represents the total source of a stream which passes through several miles of farm land. Oil content is reduced in the effluent stream from 446 to 8 p.p.m. A table shows analyses of refinery water samples. G. A. C.

181. Drying: method and equipment. W. C. Lapple and W. E. Clark. *Chem. Engng*, 1955, **62** (10), 191.—The first of 2 articles on drying is presented. Drying is defined and the process explained for the several stages in a drying operation. Stages in dryer selection are discussed, and a very wide range of equipment is described. D. J. S.

182. Why Carter likes its coker. D. P. Thornton, Jr. *Petrol. Process.*, 1955, **10** (6), 840–5.—The first commercial scale 3800-b.d. fluid coking unit has been successfully placed on stream at the Billings, Montana, refinery of Carter Oil Co, demonstrating many unique points, such as the use of any pumpable residuum, including stocks ranging from negative values of API gravity to over 20°; immunity to process upsets, including sudden stoppage or radical changes in vol, and is readily returned to production following temporary interruptions of power; clean gas oil product relatively low in heavy metal contaminants; the possible elimination of residual fuels from the refinery product list, giving the refinery a choice depending upon the market for resin; the production of small amount of C_3 and lighter, suitable for polymerization; coker naphtha of relatively high clear octane rating; wide range gas oil feed for cat cracking without further treatment and granular coke. J. H.

183. Water: how it is treated. E. Nordell. *Chem. Engng*, 1955, **62** (10), 175.—The selection of the most suitable type of water treatment depending on the quantity and impurities to be removed. Several water-conditioning processes are described in detail, and costs are discussed. D. J. S.

184. In pressure vessel design—when to use the alloy steels. W. H. Funk. *Petrol. Process.*, 1955, **10** (9), 1364–7.—This article attempts to answer the question, for a given temp range, is it more economical to use alloy steels in preference to carbon steels? Alloy steels in general have higher allowable tensile strengths than carbon steels, particularly in the upper temp ranges, and although possessing a higher initial cost, they are sometimes more economical by virtue of the use of thinner gauze metal with accompanying weight saving. The answers are given in 4 pairs of graphs which compare various steels at max service temp of 650, 750, 850, and 950 respectively. J. H.

185. How to protect your pressure vessels. C. G. Weber. *Chem. Engng*, 1955, **62** (10), 170.—The various pressure relief devices are described and the methods of installation discussed. Construction features are described, and the possibility of the use of combinations of devices is mentioned. D. J. S.

DISTILLATION

186. Universal laboratory apparatus for fractional distillation. II. Comparison between some packing materials. C. Capitani and E. Milani. *Chim. e Industr.*, 1955, **37** (12), 932–9.—As a completion and conclusion of a previous article describing an efficient lab column having the necessary requirements for universal use (batch and continuous dist under atm and

reduced pressure), a comparison between the most important and most used packing materials for dist columns is reported here. Experimental data concerning the hold-up, the capacity, and the fractionating power under different working conditions are reported for every packing under experiment. The limit of error in determining the fractionating power for the dist columns employed in this research has been established from the results of some groups of dist with the help of statistical methods. (Authors' abstract.)

CRACKING

187. Course of the methane cracking reaction. M. Rudolf and H. Voetter. *BrennstChemie*, 1955, **36** (17–18), 257–66.—Apparatus and procedure are described for investigating the reaction mechanism of CH_4 cracking. Conversions of CH_4 with air, steam, CO_2–air, and steam–air mixtures, under varying conditions, at temp >700° C on Ni–Al_2O_3–cat, at flow rates increased up to extremely short residences, are described with supporting charts, equations, and tables. Temp profile measurements in the reaction chamber show that the CH_4–air conversion rate (max 0·004 sec) is > that for CH_4–steam or CH_4–CO_2 (both approx 0·05–0·08 sec). Cat CH_4 cracking with air to CO and H_2 proceeds—not over intermediate products of complete combustion, steam and CO_2—but over a radical mechanism whose primary action is stepwise dehydrogenation of CH_4 to CH_2 on the cat. Short gas residences on the cat and different reaction velocities prevent thermal balance of the exothermic CH_4–air and endothermic CH_4–CO_2 reactions on the cat. Overheating by the exothermic CH_4–air reaction may be damped, but not prevented, by steam or CO_2 addn. 10 literature refs.

R. T.

188. High-alumina catalyst gets high score in test. O. A. Wunderlich, J. J. Prichard, and F. Emerson Ivey. *Oil Gas J.*, 17.10.55, **54** (24), 121.—A fluid cracking cat containing 25% alumina has demonstrated greater structural and cat stability than 13% alumina cat in a commercial plant test.

Reduced susceptibility to poisoning by oil-borne metals resulting in a lower-cost operation follows use of high-alumina cat. Tables show properties of cat, cat-usage, operating conditions, product distribution, and quality. G. A. C.

189. Redesigning to boost naphtha octanes. F. L. Resen. *Oil Gas J.*, 24.10.55, **54** (25), 78.—The re-vamped plant is described of the Texas Gas Corpn's Winnie installations designed to up-grade straight-run naphtha to high octane motor fuels. A 2500-b.d. platformer has been installed, resulting in increasing pool octane No. from 86·5 to 93·5. Tables show yields and characteristics. G. A. C.

190. Why did those storage vessels fail? F. L. Resen. *Oil Gas J.*, 24.10.55, **54** (25), 89.—This is a final article in a series of four by the metallurgical group at the Baytown refinery of Humble Oil and Refining Co, and is a detailed study of the regenerated-cat hopper and spent-cat vessels which failed after several years of operation. G. A. C.

CHEMICAL AND PHYSICAL REFINING

191. Refining methods for maximizing middle distillate production. L. S. Bonnell. *J. Inst. Petrol.*, Sept. 1955, **43** (381), 273.—Esso Research and Engineering Co's study of fuel consumption trends led them to believe that the demand for middle dist (kerosine, jet fuels, gas oil, and diesel fuels) is increasing. Accordingly, the refinery output should be adjusted to produce more middle dist, and refining methods suitably modified. The areas considered are the U.S.A., Canada, and Europe. Various methods of modifying refinery production are given. Several diagrams, 4 literature refs, and 2 pages of discussion are given. C. B.

SPECIAL PROCESSES

192. Autofining process. F. W. B. Porter. *Brit. Petrol. Equipm. News*, 1955, **4** (5), 55–6.—Teething troubles of the 3500-b.d. Autofiner at the Llandarcy refinery are described, with reference to a flow diagram of the process. During the period under test, the unit was taken off stream twice for the equipment to be inspected, special attention being given to study of the reactor and cat. An appendix contains many of the dimensions and unit operational details of items of equipment listed separately. E. A. G. H.

193. How the competitive urea processes compare to-day. W. H. Tonn. *Chem. Engng*, 1955, **62** (10), 186.—Several processes for the manufacture of urea are discussed. A table is used to make technical and economic comparisons, and each process is assessed. D. J. S.

194. Fractionation into products with different melting points by treating paraffin waxes with urea. R. Rigamonti and M. Panetti. *Riv. Combust.*, 1955, **9** (8–9), 712–32.—A method has been developed for treating common paraffin waxes with urea to accomplish fractionation into products having different melting points. The urea process was subsequently used on 3 types of petrolatum, enabling the extraction of compact paraffins and waxes with m.p. between 60° and 88° C. The procedure was to dissolve the petrolatum and paraffin wax in petrol, agitating with solid urea and small amounts of water: for the petrolatum the reaction had to be set off by the addition of a small quantity of preformed germ. The influence of solvent, urea, and germ quantities, as well as the agitation time, on the yield and characteristics of the products obtained was investigated. The actual loss of urea by hydrolysis during decomposition of the added germ was determined.

(Authors' abstract.)

METERING AND CONTROL

195. Is your tank gauge telling the truth? W. E. Roads. *Oil Gas J.*, 10.10.55, **54** (23), 241.—Method of calculation and use are given of a correction factor to account for that quantity of liq which vaporizes when the liq level of the tank is lowered. G. A. C.

196. Quality control instrumentation—the petroleum industry's requirements. Pt III—conclusion. G. C. Eltenton. *Brit. Petrol. Equipm. News*, 1955, **4** (5), 59–60.—An instrument is described which indicates inhomogeneity during mixing in tanks or kettles in refinery blending operations. The principle of the instrument is that electrical conductivity is imparted to lub oils by many additives, and lack of homogeneity is shown by varying audible frequencies in the detector circuit.

In concluding, the author predicts increased application of quality controlling instruments in the future. E. A. G. H.

197. The Nephelometer. A. Rabinkoff and F. A. Leisey. *Oil Gas J.*, 10.10.55, **54** (23), 174.—Details are given of the instrument (cloudmeter) used by Standard Oil Co of Indiana to reduce labour and time needed to check sediment in products. The instrument is an automotive continuous one requiring little maintenance. G. A. C.

198. New instruments and control devices available for oil processing. G. L. Farrar. *Oil Gas J.*, 3.10.55, **54** (22), 125.—A report is given on the recent 10th annual instrument–automation conference in Los Angeles. Electrohydraulic valves were on show, and 2 are described. G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

199. Chemical engineering fundamentals; general considerations in reactor design. II. T. E. Corrigan and E. F. Young. *Chem. Engng*, 1955, **62** (10), 211.—This article is devoted to the types of reaction encountered, and simple reactions of the first order are discussed, showing the effects of pressure, temp, and backmixing. D. J. S.

200. Correlation of constants in the Benedict–Webb–Rubin equation of state. L. N. Canjar *et al.* *Industr. Engng Chem.*, 1955, **47** (5), 1028–31.—Linear correlations of the 8 constants in the B–W–R equation of state are given for the *n*-paraffin series that allow of extrapolation above *n*-heptane. During the investigation separate correlations for the p–v–t data for 1-butene and 2,2-dimethylpropane were also made. B. A. F.

201. Information on the physico-chemical principles of recovery and decomposition of phenol fractions from coal tar and brown coal-low-temperature-carbonization-tar. Reports IV, V, and VI. E. Terres *et al.* *BrennstChemie*, 1955, **36** (17–18), 272–4, 275–80; **36** (19–20), 289–301.—IV. V.p. of phenol and phenol derivatives. The v.p. curves of phenol and 38 derivatives (tabulated) occurring in coal-high-temp-tar and in brown coal-low-temp-carbonization-tar are determined. The information necessary for deciding dist possibilities, normal or reduced pressure, *e.g.* for cpds less thermally stable, is given in tables and a chart.

V. Dist decomposition of the phenol fraction of coal tar and chromatographic identification of the single components.

Use of 2 columns packed with different sorts of screen wire for dist decomp of phenol fractions from coal tar is discussed. Column selectivity—one less effective, one highly efficient—is ascertained by determining the theoretical No. of plates with test mixture chlorobenzene–ethyl benzene. The phenols—largely thermally unstable—are dist at diminished pressures, whose optimum val are given in v.p. curves. The fine fractions obtained are submitted to paper chromatographic analysis, which is discussed.

VI. Investigations on the binary solvent systems of water with phenol and monovalent phenols and their crit soln temp.

Investigation of the binary systems of phenol and 32 further monovalent phenols with H_2O is reported. This includes determination of crit soln temp and phase compositions. Crit soln temp are summarized in tables and curves. Crit soln temp rises with No. and magnitude of substituents, whose arrangement on the benzene ring and relation to the –OH-group are decisively important; it increases generally as the aliphatic substituents approach the –OH-group. An exception is 2 : 3-xylenol, whose behaviour as discussed, is due to the different dipole moments and H_2O-repelling effect of the substituents. Graphs of crit soln temp as a function of mol. wt. show that the curves tend towards limit val, which are reached for the methylphenols at pentamethylphenol. From these diagrams crit soln temp for phenols not investigated here can be inferred. For mixtures of phenols with higher homologues the crit soln temp is depressed, also crit concn lowered. In the solvent system of substituted isomeric phenol mixtures with H_2O the crit soln temp coincide with the arithmetic mean of the crit soln temp of the individual systems; with mixtures of different phenol derivatives this does not prove correct. R. T.

202. Individual paraffin and naphthene hydrocarbons of the gasoline fraction of Nebitdag crude. A. V. Topchiev *et al.* *Doklad. Akad. Nauk SSSR*, 1955, **103**, 1035–8.—Fraction $\longrightarrow$ 150° C contains approx 140 cpds, of which 15 represent 50%. Paraffins ($\longrightarrow C_{10}$) 37%, 64 listed; *cyclo*pentanes (C_5–C_9) 28%, 27 listed; *cyclo*hexanes (C_6–C_9) 30%, 21 listed. Quant distribution of principal cpds is given. V. B.

203. The viscosity–temperature relationship of liquids. J. Cornelissen and H. I. Waterman. *Chem. Engng Sci.*, 1955, **4** (5), 238–46.—A new formula showing viscosity–temp relationships for a large variety of liq is proposed. It is purported to be clearer and more concise than existing equations. The range of application includes hydrocarbons and mixtures of hydrocarbons obtained by polymerization or otherwise, and mineral and fatty oils. Water, soln of sucrose in water, and sulphuric acid in water also fit into the system, while it can even be applied to mercury. E. A. G. H.

204. Flames and combustion. F. J. Weinberg. *Nature, Lond.*, 1955, **176**, 771.—Summary of some of the papers read at the British Association Meeting (Section A) in Sept. 1955.

"The Structure of Flames" (A. G. Gaydon) described information to be obtained from a study of emission and absorption spectra with respect to transient chemical species.

"The Study of Flames by Optical Means" (F. J. Weinberg) outlined the theory of the combustion process in flames, and described the methods available for their examination.

"Combustion and the Gas Turbine" (B. P. Mullins) showed how turbine combustion chamber performance can be correlated with fuel properties. The dependence of high combustion efficiency, ease of ignition and range of stable burning, freedom from carbon formation, etc., depends on the cal. val., limits of inflammability, fl. pt., visc, and v.p. in a complex fashion which is only now beginning to be systematically studied.

"The Part Played by Luminous Radiation in Furnace Heat Transfer" (M. W. Thring and C. Hulse) dealt with the radiation emanating from soot particles. The dependence of flame length, temp, and emissivity on nozzle design, preheat temp, and type and quantity of fuel was discussed. H. C. E.

205. Synthesis and structure of crystalline hydrocarbons containing asymmetric carbon atoms in the principal chain. G. Natta, P. Pino, and G. Mazzanti. *Chim. e Industr.*, 1955, **37** (12), 927–32.—The production of isotactical polymers from monomers containing a vinyl group may be carried out under various conditions. Isotactical polymers of α-olefins may be obtained by using cat of the type discovered by Ziegler for the low pressure ethylene polymerization. Isotactical, relatively low mol. wt. polypropylene has been isolated among the polypropylene polymers obtained by particular metallic oxides cat. Isotactical polymers of vinyl ethers may be prepared using boron trifluoride as cat. From the point of view of the chemical behaviour of the isotactical polymers, the depolymerization, the isomerization, the chlorination, and the oxidn have been investigated. High mol. wt. isotactical polymers keep their characteristic regular structure even under prolonged treatment, at rather high temp, with isomerization cat like aluminium halides. A rather quick depolymerization of isotactical polymers has been observed in the reactions taking place by a radical mechanism (oxidn by oxygen in the presence of peroxides, chlorination by chlorine, etc.). On the contrary, the thermal depolymerization or the depolymerization in the presence of ionic cat appears to be much slower. The chlorination of isotactical polymers generally decreases their crystallinity. Chlorinated polypropylenes and poly-α-butylenes having a chlorine content higher than 30% show no crystallinity.

(Authors' abstract.)

206. 1 : 8-Dimethyldibenzothiophen in a Kuwait mineral oil fraction. W. Carruthers. *Nature, Lond.*, 1955, **176**, 790.—The 330°–350° b.p. fraction of a Kuwait crude was extracted with furfural and the aromatic concn was treated with picric

acid. After purification the picrate was decomposed and the oil was chromatographed on alumina. Elution with benzene–petrol ether yielded the cpd, which after purification had a m.p. of 152°–153°.

Some of its chemical and physical properties are described.
H. C. E.

207. Rheological aspects of water-in-oil emulsions. P. Sherman. *Mfg Chem.*, 1955, **26** (7), 306.—Water-in-oil emulsions are described which exhibit an increase in visc and plasticity and an alteration in flow properties above a certain limit of concn. The factors which influence visc, yield value, and stability of emulsions showing plasticity are considered. There are 15 literature refs. D. K.

208. Annual conference of the British Society of Rheology. E. W. J. Mardles. *Nature, Lond.*, 1955, **176**, 819.—Report of a conference held at Exeter, Sept. 1955.

The topics discussed included lubrication by films of solid materials such as metallic stearates, waxes, polytetrafluoroethylene, MoS_2, graphite, etc.; dry and as dispersions in liq: surface films of poly-dimethyl siloxanes, which act as defoamers for oils: and the correlation between rheological properties of dispersions and the degree of wetting.
H. C. E.

ANALYSIS AND TESTING

209. API Research Project 6—analysis, purification, and properties of petroleum hydrocarbons. F. D. Rossini and S. S. Shaffer. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 14–61.—The project provides reference samples needed by the lab of the petroleum industry for calibrating spectrometers and prepares highly purified hydrocarbons of the API Research series for fundamental research measurements, and of the API Standard series for industrial or applied research, testing, analysis, and control. On the highly purified API Research hydrocarbons, the project makes accurate measurement of the freezing point for determination of purity, and of the physical properties important for record and identification.

The present work on fractionating processes for hydrocarbons from petroleum is dealt with under the following headings: fractionation and fractionating processes; regular dist; rotary concentric-tube dist column; azeotropic dist; regular dist at different pressures; dist at very low pressures; extraction; adsorption; crystallization; solid mol cpd–clathrate cpds; and 2 appendixes of 141 hydrocarbons isolated from the project's representative petroleum and of 228 API Research hydrocarbons purified up to 30 June 1954. 22 figs, 4 tables, and 22 refs. M. P. T.

210. API Research Project 44—data on hydrocarbons and related compounds. F. D. Rossini and A. L. Lyman. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 67–95.—This report describes the project's work on physical, thermodynamic, and spectral (i.r., u.v., raman, and mass) properties of hydrocarbons and related cpds. The overall purpose of the project is to prepare and maintain up-to-date a complete set of such fundamental data, critically selected, internally consistent, and compiled in a convenient form ready for use. Of the 2400 loose-leaf sheets issued up to 30 June 1954, 1154 have been revised.

The spectral data assist in making spectrographic analysis of plant streams and product materials in refining processes. The data on thermodynamic properties permit the making of reliable thermochemical and thermodynamic calculations involving heat balances, energy requirements, p–v–t and related properties, and chemical equilibria among the substances which are reactants or products in the refining processes. Although no data sheets for p–v–t and related properties have been issued, some will be available shortly.

Sections of the work include aims and principles; location, collection, and recording of the original data; appraisal, calculation, correlation, and processing of the data; compiling and printing the tables of data; uses of the data on physical and thermodynamic properties; summary of the loose-leaf data sheets issued; physical and thermodynamic data on punched cards; p–v–t and related properties; spectral data; API research hydrocarbons; and distribution of the loose-leaf data sheets. 12 refs, 13 tables. M. P. T.

211. API Research Product 48—synthesis, properties, and identification of sulphur compounds in petroleum. J. S. Ball, F. G. Bordwell, H. M. Smith, G. Waddington, and W. D. Seyfried. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 106–47.—The objectives of this project are obtaining data on sulphur cpds found in petroleum and in identifying individual and type sulphur cpds in a typical (Wasson) high-sulphur crude oil.

The project has succeeded in developing methods for the synthesis of thiols by the addition of thiolacetic acid to olefins, followed by hydrolysis. By the use of this approach with halo olefins a synthetic route for the preparation of cyclic sulphides has been developed. Studies on the synthesis and chemistry of benzothiophenes and on the chemistry of oxidn have yielded important data regarding these types of sulphur cpds.

Although sulphur cpds are generally considered to be harmful in petroleum products, the effect of the sulphur content depends considerably on the type of cpd present. Consequently, a systematic scheme of analysis has been developed for the various types of sulphur cpds present in petroleum. One of the least satisfactory aspects of the U.S. Bureau of Mines' method is the failure to differentiate thiophene and its homologues from aromatic sulphides. Thus, a published method for the determination of thiophenes has been modified, and recoveries of 97 $\pm$ 4% of the thiophene added to naphtha have been obtained.

Significant amounts of new data have resulted from systematic thermodynamic studies of sulphur cpds. Entropy and heat-of-combustion data—and, hence, free radicals—are now available for the isomeric C_3H_8S and $C_4H_{10}S$ alkane sulphides and thiols as well as for a number of other cpds.

Recent findings have resulted in a much clearer picture of the sulphur cpds throughout the entire boiling range of Wasson crude oil. Adsorption on alumina has been applied successfully to concentrating the sulphur cpds in several boiling-range dist; thiols have been separated quantitatively by the use of sodium aminoethoxide in ethylene–diamine soln; chain and cyclic sulphides have been separated by zinc chloride and by adsorption or thermal diffusion; and studies of topped deasphaltened Wasson crude oil show that benzothiophenes with 1, 2, 3, or more aromatic rings are the predominant sulphur cpds present.

An improved procedure has been developed for the determination of total sulphur by X-ray absorption and polerographic procedures for the determination of polysulphides, and their possible thermal decomposition products have been studied. Finally, a limited investigation of the reaction of elemental sulphur with hydrocarbons was initiated. 9 figs, 21 tables, including relative API publications, 18 refs.
M. P. T.

212. API Research Project 50—thermodynamic properties of hydrocarbons and related compounds. K. S. Pitzer, G. C. Pimentel, and R. R. Brattain. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 148–51.—Research has been directed towards new and improved methods for thermodynamic data on hydrocarbons and related cpds. The theoretical methods involved the statistical mechanical calculation of thermodynamic properties from mol-structure data, in addition to the thermodynamic relationships between the various functions.

The project proposes to further develop those theoretical methods for the calculation of thermodynamic functions from mol data and to establish the essential mol data characteristics of hydrocarbon and closely related mol.

Recent work includes studies on internal rotation about single bonds; naphthalene (as a basis for naphthalene derivatives); and correlations of the volumetric and thermo-

dynamic properties of imperfect gases and liq. An appendix lists the project's technical publications. 1 fig, 4 refs.
M. P. T.

213. API Research Project 52—nitrogen constituents in petroleum. J. S. Ball, C. A. van der Werf, G. Waddington, and G. R. Lake. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 152–65.—Since this project was established on 1 July 1954 it has only limited progress to report. The principal objective, however, is to develop fundamental information and basic data concerning the nitrogen constituents of petroleum.

This research is of the utmost urgency for, as is well known, nitrogen cpds, even in trace amounts, cause serious problems in the processing of petroleum and in the storage of petroleum products, *e.g.* they reduce the activity of cracking cat—especially in cat charge stocks during the conversion to gasoline; and they poison other cat, such as those used in reforming, polymerization, and isomerization. Further, as little as 0·01% of nitrogen as pyrole markedly increases the rate of formation and the amount of insoluble gum formed on storage of fuel oils. Nitrogen cpds also tend to the formation of soluble and insoluble gums on the storage of diesel fuels.

The project intends to develop separation processes which may be used to isolate individual cpds or groups of cpds. It will also develop methods of synthesis for nitrogen cpds.

Highly specialized measurements will be made of the thermodynamic properties of the pure nitrogen cpds. The resultant data will be used to calculate the heat and free energies of formation of these cpds.

Thus, the project aims at giving industry the tools to solve the problems of cat poisoning, product instability, and fuel deposits, as well as contributing towards an understanding of how petroleum is formed. 1 fig, 3 tables, 2 appendixes—of which one gives the nitrogen cpds isolated from petroleum.
M. P. T.

214. Aviation lube tests a problem. F. G. Hess, F. E. Landis, and A. L. Rescorla. *Petrol. Process.*, 1955, **10** (9), 1374–7.—Present-day bench-scale screening tests for predicting the deposit forming and corrosion characteristics of aviation lub oils have many times proved to be inadequate. A method developed by Cities Service Research and Development Co consists essentially of oxidizing an oil at 300° F and subjecting the oxidized oil—in the form of a fine spray—to temp of 550°–900° F. Corrosiveness of bronze test-pieces was determined in both the liq and the vapour phase. Carbon formation was measured by weighing the deposit formed on the heated surface. Changes in the properties of the oils were determined from the materials analysis, which consisted of naphtha insolubles neutralization number, and visc.
J. H.

215. Continuously recording oxidation apparatus for hydrocarbon oils. D. G. Childs. *J. Inst. Petrol.*, Sept. 1955, **43** (381), 283.—An apparatus for determining the oxygen uptake of insulating oils is described. The oxygen is circulated continuously, and the decrease in vol is automatically recorded. The apparatus can be used for the comparison of antioxidants, and also for assessing the oxidn stability of straight insulating oils. Several illustrations and 14 literature refs are given.
C. B.

216. The evaluation of greases for ball and roller bearings at low temperatures. J. W. Pearson. *J. Inst. Petrol.*, Sept. 1955, **43** (381), 290.—An apparatus is described which can be used to determine low temp properties of lub greases. Measurements of starting, breakaway, and running torque may be made, at constant shear stress, or constant rate of shear. Provision for thrust loading is made, to minimize skidding of the balls in the bearing. A method of interpretation of results is given, which may help to reduce the variations in assessed low temp properties due to differences in the test bearings. Several illustrations and 14 literature refs are given.
C. B.

217. Note on the natural evolution of petroleum. F. Bienner and M. Louis. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 337–9.—Mixed- and paraffin-base crudes evolve in air and light towards asphalts of the more naphthenic type. First there appear resins, then asphaltenes, and finally carbenes and carbenoides. The latter are particularly constituents of asphaltites.

A naphthenic crude from Mirando, Texas, was put as a 2–3-mm layer in a Petri dish for several months in summer and became more and more viscous. Samples were analysed at intervals. As with paraffin- and mixed-base oils, resins appeared at the expense of the oily components. There was a change towards less and less naphthenic bodies, and an increase in the potash number with time. In the mixed- and paraffin-base crudes the loss of paraffins by oxidn leads to enrichment in naphthenes.
G. D. H.

218. The mass spectrometer in refinery control. D. Crowe. *Inst. Petrol. Rev.*, 1955, **9** (98), 29.—The analytical mass spectrometer was first introduced into a refinery about 12 years ago, and is now accepted as the best means of carrying out large numbers of multi-component gas analyses, largely as a result of its high work-load and short pay-back time. It is used for the analysis of gases or volatile liq. After describing the theoretical considerations, the author gives a number of examples. Typical of the rapidity of operation is that, for the average refinery gas sampling schedule, 20 samples may be analysed in an 8-hr day. Details of cost and accuracy are considered, and the question of operation and maintenance discussed. Examples of practical application include: (1) analysis of olefin-free hydrocarbon mixtures in the 80°–231° F boiling range, involving 28 individual paraffin and naphthenic isomers, together with benzene and toluene; (2) determination of aromatics in hydrocarbon mixtures; (3) analysis of oxygenated and halogenated cpds (including alcohols, ketones, acids, and esters); (4) type analysis.

The scope of the instrument has been extended to cater for high mol. wt. cpds, *e.g.* lub oils, waxes and asphaltenes, and oil additives. The instrument is also being used on a continuously recording basis for the purpose of plant control. Of future development, expectation is that the instrument will continue to make outstanding contributions to refinery analytical work.
R. H.

GAS

219. Study of the conditions of formation of natural gas hydrates. R. Fagegaltier. *Rev. Inst. franç. Pétrole*, 1955, **10** (7), 751–4.—The cell, made of steel, had 2 opposite faces of thick glass extending the full length. Its max working pressure was 150 kg/cm², and its capacity *ca* 150 ml. To avoid attack by H_2S it had a Teflon lining. In use the pressure was kept constant and the temp was varied slowly. The cell was initially full of water, and all but *ca* 15 ml was displaced when the gas was introduced. The temp was reduced below 3° C. On agitating the cell, hydrates formed and there was a drop in pressure. The temp was raised slowly (*ca* 1° C in 2 hr) until the hydrates disappeared, the temp and pressure being noted at this stage. The temp was dropped by 0·5° C and again raised. The experiment was repeated at higher pressure.

The Lacq gas had 0·1% CO_2, 2·9% N_2, 92·3% CH_4, 4·16%, C_2H_6, 0·54%, C_3H_8 (mol percentages). Hydrate formation was at 7·2° C under 27·6 kg/cm², and 18·6° C under 140 kg/cm²; the calculated temp were 6·1° and 18·3° C, respectively. The experimental and calculated results are compared with data for methane.
G. D. H.

220. Isentropic compression of non-ideal gases. J. M. Prausnitz. *Industr. Engng Chem.*, 1955, **47** (5), 1032–3.—The general analytical treatment is based on the ideal gas with corrections at the initial and final states of compression for the non-ideal behaviour of real gases. The corrections are found by applying the appropriate equations of state. Calculations are in good agreement with experimental results for ethylene, ammonia, carbon dioxide, Freon 12, and methyl chloride.
B. A. F.

ENGINE FUELS

221. API Research Project 45—synthesis, purification, and properties of hydrocarbons of low molecular weight. C. E. Boord and W. G. Lovell. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 96–105.—The project has as its primary objectives the development of hydrocarbons within the gasoline boiling range and the determination of their knocking characteristics in I.C. engines. 296 cpds have been produced, purified, and examined; and over 7000 items of engine-evaluation data have been tabulated.

All the members of the paraffin series through C_8 have been engine tested, as well as 27 paraffins with a larger number of carbon atoms. In the olefin series, data have been obtained on all 13 of the structurally isomeric hexenes and on all but one of the geometric forms. Complete data for the 36 isomeric hexenes (including geometric forms) are nearing completion. 59 members of the *cyclo*paraffin series have been engine tested and 28 *cyclo*hexanes have been produced. The engine data tables cover 39 aromatic hydrocarbons through C_9 and approx one-half of C_{10}. Recently, emphasis has been placed on mono-olefins and cyclic unsaturates.

The framework of the project covers syntheses in the olefin series; hydrocarbon structure and engine behaviour; the heptanes; heptenes and heptanes; the octanes; discussion of the reaction mechanism; and the conclusion that for non-cyclic paraffins and olefins the presence of a methylene group (CH_2) exercises a deleterious influence upon the knock resistance of a hydrocarbon.

However, the methylene group is not the only structural feature affecting the knocking characteristics. Other structural units not yet clearly defined become operative in those hydrocarbons which do not contain this grouping. These undefined structural units may also be determinative in those hydrocarbons which contain an equal number of methylene groups. 8 tables, 22 refs, 5 figs. M. P. T.

222. B.T.H. gas turbine starter. Anon. *Gas Oil Pwr*, 1955, **50**, 285.—*iso*Propyl nitrate, the fuel employed in this starter, needs no air for combustion. It can be decomposed by heat and pressure, which are provided by firing a cartridge into the starter combustion chamber. The flow of fuel into the chamber is started by the pressure, and its subsequent decomposition maintains the pressure. The expanding gases then turn a small turbine wheel connected to the engine through gears.

This system has 3 main advantages. The current required is less than 1 amp. The pressure developed by the cartridge being low, the initial engagement of the starter is gentle. Since the fuel is contained in small cyl, each of which is sufficient only for one operation, safe conditions are obtained if the system does not start. H. C. E.

223. Antioxidant sweetening of gasolines. C. M. Barringer. *Industr. Engng Chem.*, 1955, **47** (5), 1022–7.—The rate of antioxidant sweetening is related to the reactivity of the treated hydrocarbon and to the mercaptan present. The presence of oxygen and a strong base as well as a *p*-phenylenediamine is necessary for a successful reaction, as was indicated by a series of experiments with simplified mercaptan–hydrocarbon systems. A possible mechanism to explain the experimental behaviour was developed. B. A. F.

224. Cornwall aircraft fueller. Anon. *Fluid Handl.*, 1955, 277–8.—B.P. Aviation Service's recently introduced new mobile fueller has 3400 I.G. capacity with 2500 I.G. capacity trailer. Latest type dispensing equipment, employing B.P. low loss circuit with auxiliary defuelling facility, has max pumping capacity of 500 g.p.m., with into-aircraft pressure of 50 p.s.i. "Straight through" nature of low loss circuit is illustrated by line diagram. B. S. W.

GAS OIL AND FUEL OIL

225. Papers at the joint conference on combustion. Anon. *Petrol. Times*, 11.9.55, **59** (1520), 1163.—Summaries are given of papers from Section I (General) and Section II (Boilers) read at the joint conference of Institution of Mechanical Engineers and American Society of Mechanical Engineers in London, Oct. 1955. Subjects include chemistry and physics of combustion, scientific principles of combustion and their application, instruments, methods of disposal and elimination of waste gases, liq fuel firing, etc. G. A. C.

226. The combustion of atomized fuels. Pt II. Anon. *Petrol. Times*, 28.10.55, **59** (1519), 1103.—Fundamental problems in this subject are discussed, in particular this part considers time requirements for mixing air and particles and flame radiation. G. A. C.

227. Tackling the residual fuel problem. Pt 1. Anon. *Oil Eng.*, Aug. 1955, **23** (266), 161.—Description of work done at Esso Development Co on the problems arising from the use of residual fuels in gas turbines—primarily corrosion and deposition. Rig tests were carried out at various temp using kerosine as the test fuel, with various amounts of vanadium and sulphur added, in order to study the effects of the ash on corrosion and deposition. The effects of additives were also studied. Tests on a gas turbine burning residual fuel were carried out, and results are given of test runs using magnesium salts to reduce corrosion. The value of the rig tests is discussed. The paper is illustrated with several photographs and diagrams, and one literature ref is given. C. B.

LUBRICANTS

228. Lubricant for diesels burning heavy fuels. Anon. *Gas Oil Pwr*, 1955, **50**, 279.—Commercial lub oil additives were tested in an engine fitted with a radio-active piston ring, and the rate of wear, determined by measurement of the radioactivity of the crankcase oil after test, was compared for various additives. It was found that the rate of wear decreased as the alkalinity of the used oil increased. On the basis of these tests 3 additives were selected for field tests in marine engines. Aniline was also found to be an effective additive, but was not used in field tests on account of its toxicity.

These tests were continued over 3 years on engines of differing make and size in 11 ships under conditions standardized as much as practicable. Half of the cyl of each engine were operated with the experimental oil and the other half with regular oil, which varied from ship to ship. The fuel used varied from 1756 to 300 Rod I sec and the S content from 1 to 12·5%.

Under these conditions all 3 additives were equally effective and the average reduction in wear was 20%, but there was no correlation between wear rate using regular oil and reduction in wear.

Data illustrate the net monetary saving when the higher cost of the lub oil is offset against the reduced cost of maintenance and replacements. The oil containing the selected additive is of SAE 50 grade. H. C. E.

229. Some technical developments in tractor lubrication. C. S. Bates. *Petrol. Times*, 11.9.55, **59** (1520), 1157.—Visc, V.I., pour point, additives, oil change periods, and selection of crankcase oils are surveyed, and future developments outlined. The article is an abridgement of the author's paper "Technical Developments in the Lubrication of Tractors." G. A. C.

230. API Research Project 42—synthesis and properties of high-molecular-weight hydrocarbons. R. W. Schiessler and H. Sutherland. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 62–6.—The properties of an oil are determined by the properties of the individual chemicals, principally hydrocarbons, which

comprise the oil. The properties of these individual chemicals are determined by the architecture of their mol.

The project prepares, purifies, and studies the properties of model hydrocarbons in order to obtain a better understanding of the behaviour of oils in the lub oil range. The availability of pure hydrocarbons of known structure is essential to such a study, and much time must be spent in the preparation and purification of the hydrocarbons selected.

The purification problems arising from the small differences in physical properties for similar mol at high mol. wt. are noted, and typical applications of fractional dist, fractional recrystallization, adsorption, urea adduction, and chemical treatment in purification are mentioned.

Care has been taken to avoid the pitfall of misleading literature, *e.g.* in the preparation of tri(α-decalyl)methane, which, instead of leading to tri(α-naphthyl)carbinol, had, by an unusual 1,4 addition of a Grignard reagent, involved a multiple linkage in an aromatic nucleus. Thus, a new synthesis was devised, involving the reaction of 1-naphthyllitum with diethyl carbonate, which produced the desired product.

Hydrogenation was widely used in hydrocarbon preparation, and the chief tool employed for purification was dist through fractionating columns. A table shows the effect of mol. wt. on b.p. differences for C_6 and C_{26} hydrocarbons. 16 refs.
M. P. T.

231. Composition of lubricating oil portion of petroleum. B. J. Mair and F. D. Rossini. *Industr. Engng Chem.*, 1955, **47** (5), 1062–8.—In 1938 the API conducted an extensive fractionation examination of the lub oil fraction of a representative crude oil. Recently, modern methods have been applied to the samples obtained in the initial survey. 15 lab obtained mass spectral data, i.r. and u.v. data, and the results of both investigations are summarized and correlated to give information on the types and quantities of hydrocarbons present in the lub oil fractions of petroleum. B. A. F.

BITUMEN, ASPHALT, AND TAR

232. Relationship between plasticity and chemical structure of bitumen. K. Krenkler. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (9), 295–305.—To clarify conflicting opinions on the val of bitumen decomp with selective solvents, the relationship between plasticity and colloido-chem structure is investigated. The report covers 37 bitumens of German origin, others of different origin or with extreme properties. With Nellensteyn's ether-asphaltenes the relationship is indistinct; *n*-heptane-asphaltenes show a relationship affected by other factors. Benzene-insol occurring in some bitumens does not affect the plasticizing effect of the asphaltenes. *cyclo*Hexane-insol in certain bitumens—consisting of thermal decomp products—has *ca* ½ the plasticizing effect of the optimum asphaltene. Some bitumens give appreciable quantities of ½-*cyclo*hexane-insol (50 : 50 heptane–*cyclo*hexane), consisting chiefly of thermally-affected asphaltenes. By deducting ½ of the D-½-*cyclo*hexane-insol from the total *n*-heptane-insol a corrected val for *n*-heptane-insol is obtained which agrees well with the plasticity range found. Higher D-asphaltene cont, lower resin cont, and aromatic-lean oils confer greater plasticity. Excess *cyclo*hexane-insol and ½-*cyclo*hexane-insol, high resin cont and aromatic-rich oils cause lower plasticity. Resin cont—determined by butanol-insol has a dispersive effect and lowers plasticity. The ratio resins : asphaltenes is very informative for plasticity. Procedure, and results in charts are discussed. 32 literature refs. R. T.

233. Mixtures of blown bitumens and of blown with distilled bitumens. Anon. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (99), 312–13.—Brief note on changes in properties caused by various admixtures of bitumens, supported by charts and a tabulation. R. T.

234. Moisture migration and vapour arrest. A. W. Rick. *Bitumen, Teere, Asphalt, Peche*, 1955, **6** (9), 314–16.—In a comprehensive article on moisture wandering and damming in roofs and buildings, use of bitumen is discussed. R. T.

SPECIAL HYDROCARBON PRODUCTS

235. The combustion of fluid petroleum coke. Anon. *Petrol. Times*, 28.10.55, **54** (1519), 1111.—Full-scale combustion tests are described using fluid petroleum coke in rotary kiln operations at the plant of a cement company, from which it is concluded that with proper handling and design of facilities, the coke can be burned with good combustion characteristics. An analysis of the coke is given. G. A. C.

DERIVED CHEMICAL PRODUCTS

236. Methyl mercaptan from methyl chloride. C. B. Scott *et al. Industr. Engng Chem.*, 1955, **47** (5), 876–7.—Because future demand for methyl mercaptan may exceed supply from the present petroleum sources, numerous syntheses were investigated. The reaction between sodium hydrosulphide and methyl chloride was investigated in a semi-[illegible] plant which was designed to give good contacting of reactants and to operate at approx 175 p.s.i. to provide a high concn of reactants. Side reactions were effectively suppressed by feeding an excess of hydrogen sulphide, and efficiencies of over 98 mol % were obtained. B. A. F.

237. Mechanical properties of flexible polyvinyl chloride and their relationship with the molecular structure of the plasticizer. C. Lutzu. *Chim. e Industr.*, 1955, **37** (12), 953–7.—Some of the mechanical properties of blends of PVC with a number of plasticizers derived from oligomers of methacrylic acid have been examined systematically. It has been found that changes of the more significant structural elements of the mol (number of polar groups and length of the aliphatic chain) bring opposite effects upon the variation of the secant modulus at 100% and of the tensile strength, depending upon the concn of the plasticizer. The shape of the stress–strain diagram for blends with the same wt concn of the polymer has been found to be dependent upon the mol. wt. of the plasticizer even for cpds having the same saponification No. The stress–strain low speed hysteresis did not show regular variations by varying gradually the mol structure of the plasticizer. (Author's abstract.)

COAL, SHALE, AND PEAT

238. Capacity of coals, especially brown coals and lignites, for combination with water. D. J. W. Krevelen. *Brennst-Chemie*, 1955, **36** (17–18), 266–71.—Absence of a break in the temp–H_2O curve shows that H_2O evolved at higher temp from coals previously preheated to 100° C is not due to decomp. Desorption isobars of a brown coal determined at different v.p. clearly distinguish weakly and strongly assimilated H_2O. The former obeys the general sorption laws, and calc heat of sorption corresponds approx to the molar heat of vaporization of the H_2O. Obviously combination of this H_2O is attributable to the gel structure. The latter—even in very dry atm—cannot be expelled at ordinary temp. The curve showing the quantity of assimilated H_2O as a function of preheating temp has no break at the decomp temp, indicating that this H_2O is connected with the inner coal surface, not with its gel structure. 11 literature refs. R. T.

239. Results of coke microscopy using most varied research methods. M. T. Mackowsky. *BrennstChemie*, 1955, **36** (19–20), 304–14.—Coke texture measurement adopted by E. Hoffmann and E. L. Kühlwein is examined critically. Characteristics of a homogeneous coke and inhomogeneities are investigated. Homogeneous cokes are necessary for good tensile properties and regular combustion in the blast furnace. Photomicrographs furnish valuable information on homogeneity. Relationship between optical character of the cokes and their reactivity or conductivity are discussed. 8 literature refs. R. T.

CORROSION

240. The problem of protection against corrosion. C. Bianchi. *Riv. Combust.*, 1955, **9** (8–9), 675–711.—A general review of the problem based on the thermodynamic and kinetic aspects of corrosion phenomena is followed by a classified list of the various methods of passive and active protection, as well as the protective measures taken to combat corrosion due to wandering currents. Cathodic protection is dealt with separately and in detail from the electrical and the electrochemical standpoints, showing how these 2 viewpoints may be amalgamated to develop a treatment more strictly adherent to theory yet closer to technological practice. The subject is carried further in the discussion on valuation of the state of protection of a buried structure, to identify those cases where the vicinity of 2 structures interfering with each other renders inadequate the usually adopted measures of protection.
(Author's abstract.)

241. An economic survey of underground corrosion prevention methods. D. C. Glass. *Pipe Line News*, 1955, **27** (6), 45–55.—Data from 32 pipeline operating companies has been analysed to give initial and operating cost of the various types of protection used in pipeline service. The analysis shows that 95% of new lines have a protective coat. Cathodic protection data indicates that rectifier power cost/mile/year for coated pipe averages $7.12. Rectifier current for bare lines/mile/year averages $53.41. Indications are that half of the companies have over 90% of their facilities under cathodic protection. B. A. F.

242. Use of inhibitors of internal corrosion in the Le Havre–Paris pipeline. J. Vincent-Genod. *Bull. Ass. franç. Tech. Pétrole*, July 1955, (112), 405–18.—Experience on the use of corrosion inhibitors in pipelines is much less extensive than that in refineries. It was decided to use $NaNO_2$ in aq alkaline soln rather than an inhibitor soluble in hydrocarbons. This had to be injected at each filter or relay station. The inhibitor caused the elimination of much scale from the pipe, and then the amount of sediment decreased, and also became very fine. Data are given on the amount of inhibitor used, and on the nitrite in the effluent over a period of nearly 2 years. There is also information on the amount of sediment recovered. A test coupon inserted in the pipeline 9 months after beginning the use of inhibitor showed no corrosion in 6 months.

An organic inhibitor (an acetate of an aliphatic amine) has also been used in aq soln for 3 months after the nitrite. Practically no sediment was recovered, and there was no corrosion of a test coupon.

The injection equipment is described. G. D. H.

243. Best intervals for cathodic-protection units. V. A. Barnato. *Oil Gas J.*, 10.10.55, **54** (23), 238.—A combination of theoretical design from data from files and actual field tests and observations is recommended to determine optimum intervals of rectifier stations. Cases where there are no interference problems and where such exist are considered. G. A. C.

244. Cathodic protection of tank bottoms. J. J. Meany. *Oil Gas J.*, 24.10.55, **54** (25), 95.—A case history is given of protection of 2 storage tanks, complicated by stray currents and a cinder fill, but simplified by burying anodes and reference electrodes beneath the tank. Tests showed that the null circuit method was the only one capable of establishing the true amount of cathodic protection current required. G. A. C.

245. Thin film coating of tank bottoms. P. Murphy. *Oil Gas J.*, 10.10.55, **54** (23), 256.—Service Pipe Line Co have developed a new procedure in applying a thin coating of epoxy-coal tar copolymer with a spray gun to tank bottoms. 2 coats give a thickness of *ca* 20 mils. G. A. C.

246. "Juice" cheaper than downtime. W. A. Johnson. *Petrol. Process.*, 1955, **10** (9), 1372–3.—Corrosion fighting by cathodic protection can be applied with satisfactory results on buried lines and metallic structures in the petroleum processing plant. A typical installation of such equipment is at the 25,000-b.d., Corpus Christi, Texas, refinery of South Western Oil Refining Co. Installation cost was less than $20,000. No known corrosion has occurred in the 3 years the cathodic protection system has been in service on some 47 storage tank bottoms and their interconnecting piping. J. G. H.

ENGINES AND AUTOMOTIVE EQUIPMENT

247. Automobiles and petroleum: past, present, and future. J. J. Broeze. *Proc. Instn mech. Engrs, Lond.*, 1953–54, 135–41.—Achievements as a result of over 50 years co-operation between the automobile and petroleum industries are discussed. Especial attention has been paid to the development of the modern 4-stroke I.C. engine, and how design has been assisted by a better understanding of fuel and lubrication problems.

A comparison is made between U.S. and European engines and their performance, and the recent reduction in cyl wear is noted. Transmission is dealt with in general terms, with emphasis on the introduction of the hypoid gear. Recent developments in refining also receive attention.

In the near future the author sees conservative developments along existing lines, with gradual developments in the improvement of quality petrol, notably in its anti-knock level, and a gradual adaptation of the engine to accommodate this fuel. Thus, the trend in fuel technology will lead to higher octane fuels and, thereby, increased C.R., but their limit is a matter for conjecture.

Some enthusiasm is expressed for the development of the Schlamann engine, with an injection pump fitted into the ignition chamber, and a carburettor adding the required fuel into the main air stream. It is claimed that with suitable dimensions and controlled turbulence the flame issuing from the ignition chamber will regularly ignite the mixture in the cyl under any condition of load and speed, so that even idling can be achieved with an unthrottled air inlet.

The gradual lowering of the sulphur content of fuels for diesel engines is likely to lead to unheard of achievements in design. Developments are also forecast in the piston-plus-turbine system, and for the increase of petroleum products—especially plastics for bodywork.

In the distant future, as long as petroleum is available it is likely to dominate automobile design. Although the petroleum industry is known never to have proven reserves for more than 25–30 years ahead, recent advances in exploration and production will lead to a considerable extension of that period—in spite of the ever increasing demand for petroleum and its products. M. P. T.

MISCELLANEOUS

248. Isotopes revolutionizing oil operations. G. Weber. *Oil Gas J.*, 31.10.55, **54** (10), 48.—Definition, sources, availability, and manners of use of isotopes are reviewed, and a table of isotopes licensed for use in the oil industry in the U.S.A. are given. G. A. C.

249. Prevention of atmospheric pollution in the carbon black industry. D. L. Allan. *Chem. & Ind.*, 1955, 1320–4, disc. 1374–5.—Impingement, thermal, and furnace processes for carbon black production are outlined. Agglomeration of particles by electrostatic precipitation and their collection by cyclones, water-scrubbers, and wet electrostatic precipitators are described. Replacement of scrubber–precipitator units with bag filters eliminates production of highly corrosive slurries. Improvements in bag life should result from use of silicone-treated glass fabrics and polytetrafluorethylene material. B. S. W.

ADDITIONS TO THE LIBRARY

Physical-chemical Properties of Ethane–nitrogen Mixtures. B. E. Eakin, R. T. Ellington, and D. C. Gami. Institute of Gas Technology Research Bulletin No. 26. Chicago, Ill.: The Institute, July 1955. Pp. 40. $5.00.

Data are presented in liquid–vapour phase equilibria, gas phase p.v.t. relationships, and saturated liquid and vapour densities for the ethane–nitrogen system. The work completes publication of the IGT studies on binary mixtures of methane, ethane, and nitrogen.

Chemistry of the Solid State. Ed. W. E. Garner. London: Butterworths Scientific Publications, 1955. Pp. viii + 417.

Diesel Engine Principles and Practice. Ed. C. C. Pounder. London: George Newnes, 1955. Pp. xiii + 848.

Reviews of Petroleum Technology, Vol. 14 (1952–54). London: Institute of Petroleum, 1955. Pp. vii + 232.

British Standards:

B.S. 2634: 1955, Pt I. Roughness Comparison Specimens. Pt I—Ground Cylindrical Type (Primary Texture). Pp. 10. 2*s.* 6*d.* net, post free.

B.S. 1733: 1955. Flow Cups and Methods of Use (for the Consistency Control of Industrial Materials such as Paints and Varnishes). Pp. 13. 3*s.* net, post free.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

250. Geochemistry of subterranean waters: application to oilfield waters. H. Schoeller. *Rev. Inst. franç. Pétrole*, 1955, **10** (8), 823–74.—Brief reference is made to the Chase–Palmer classification of oilfield waters, and then a classification is discussed which groups the waters first according to the order of dominance of Cl, SO_4, and CO_3, and secondarily according to the relative amounts of Na, Mg, and Ca. Of 36 possible groupings arising thereby, only 8 occur in oilfields, and often the ratios SO_4/CL, Mg/Ca, and Cl–Na/Cl are adequate for grouping. The various groups are discussed, and then the oilfield waters of a number of areas are briefly described.

The subsurface waters of various areas and formations are considered, according to whether they are normal, associated with organic matter or with igneous activity. Top, bottom, and edge waters are examined, and also the variation in composition within a single formation. Examples of increase in concn with depth are given.

The composition of waters in the sea, closed basins, in concentrated seas, and in marine muds is given. The various possible modes of origin of oilfield waters are set out, and the means whereby they may be modified are enumerated. The penetration of marine or fresh water into sediments is considered.

An extensive bibliography is appended. G. D. H.

251. Grayson County geology has everything. H. H. Bradfield. *Oil Gas J.*, 22.8.55, **54** (16), 111.—The geology and history of exploration of Grayson County, Texas, are described. The area has all the requirements of a petroleum province, and the first field was found in 1946. Many different types of fields have since been discovered, and prospects are good.

Geological conditions are complex, Palæozoic rocks being

obscured by a blanket of Lower Cretaceous increasing from 600 to 3060 ft in the SE. part of the county. Production is from Palæozoic rocks, which are uplifted and faulted along NW. to SE. trend lines. C. A. F.

252. New Texas area opened. Anon. *Oil Gas J.*, 5.9.55, **54** (18), 76.—A field has been found in the N. end of the Rio Grande embayment in SW. Texas, an area hitherto not found productive. The discovery, 1 Brite, is 5 miles from the Mexican border in Val Verde County, and pay is Lower Cretaceous Edwards limestone perforated from 760–772 ft and 790–800 ft; oil gravity is 36·8°.

Nearest production is 60 miles to the N. in the Vinegarone area, where there is gas and condensate production from the Pennsylvanian Strawn at *ca* 10,000 ft, and at Chittim, 80 miles SE., where Cretaceous Trinity produces gas and dist.

C. A. F.

253. Salt mark broken. Anon. *Oil Gas J.*, 22.8.55, **54** (16), 98.—2 Caffery, St Mary's Parish, Louisiana, penetrated 13,362 ft of salt before completion at *ca* 14,000 ft. On tests the well flowed 228 b.d. of 33·5° oil with 232,000 cu. ft. gas.

Top of the salt is at 818 ft, and a salt penetration record is claimed. C. A. F.

254. Offshore record broken. Anon. *Oil Gas J.*, 22.8.55, **54** (16), 98.—A new field has been discovered 35 miles offshore from Terrebonne Parish, Louisiana. This is the furthest offshore discovery, and the new well is in 55 ft of water, producing from Miocene sand at 6196–6222 ft. Tests showed 595 b.d. of 29° oil.

67 wells have now been drilled in the Louisiana shelf, and 23 fields have been found to date this year. C. A. F.

255. Coleville–Saskatchewan's largest oilfield. C. J. Hamilton. *Oil Gas J.*, 15.8.55, **54** (15), 126.—The geology of the Coleville field in Saskatchewan is described; it is 30 miles E. of the Alberta border, midway between Kindersley and Kerrobert, and is the largest oilfield in Saskatchewan.

The 2 main pays are Mississippian Coleville (oil) sand and Upper Cretaceous Viking (gas) sand, and there are 3 other zones which are possible oil and gas pays. Structurally the field lies in the northwest extension of the Sweetgrass arch and the local feature is an E.–W. trending anticline with a sharp reversal on the N. side.

A cross-section shows some of the structural and stratigraphic features of the field. C. A. F.

256. Birth of a basin. F. J. Gardner. *Oil Gas J.*, 29.8.55, **54** (17), 143.—1 Sancti Spiritus near the Jatibonico field, central Cuba, has penetrated over 9000 ft of Tertiary sediments and established the presence of a Tertiary basin S. of the field. The section is similar to that of the Texas–Louisiana Gulf Coast, and the reservoir and source beds of Jatibonico thicken rapidly away from the field. Sands are highly porous and permeability good.

The discovery of this basin is considered to be the most important development so far in exploration in Cuba.

C. A. F.

257. Stratigraphy in the Neocomian and Upper Jurassic of Lacq Well 104. J. Cuvillier. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 316–18.—Well 104 passed through mollasse, Lower Eocene, Campanian, Upper Cretaceous, entering the Neocomian at *ca* 3350 m and the Jurassic some 300 m deeper. Continuous coring provided detailed information on these beds, and this is summarized. The Neocomian extends from 3351 to 3546 m, and the Valanginian underlies this down to 3674 m. The Neocomian is marly and brackish, with some anhydrite zones, and progressively more limestone and a more marine character in its lower part. The latter condition is seen in the Valanginian. The principal fossil types in nearly a score of groups in these formations are given.

The uppermost Jurassic shows marls becoming more and more sandy, and sandstones with rare dolomitic layers to 3692 m. Below down to 3838 m are dolomites, largely devoid of identifiable fossils. Dolomites and dolomitic limestones occur from 3838 to 3900 m, and some 50 m deeper are fissured dolomites followed by compact limestone. Below 4000 m are marly limestones, some sandy zones, and dolomitic bands. The well was 4350 m deep, and it probably reached the Lusitanian.

The Neocomian included short lacustrine phases.

G. D. H.

258. Geological and geophysical exploration in Yugoslav petroleum areas 1945–55. F. Ozegovic. *Nafta* (*Yugoslavia*), 1955, **6** (8), 243–9.—The first oil well in the territory of today's Yugoslavia was drilled in 1868 in the district of Medimurje, Croatia. Systematic geological mapping was only started in 1926–27. Around 1930, geomagnetic measurings were carried out in Medimurje, and around 1934 the Ulcinj district, Montenegro, was explored geoelectrically. Up to 1949, 190 oil wells totalling 75,000 m of length were drilled, namely in Croatia, 162 wells with 45,000 m length, Bosnia, 27 wells with 27,900 m length, and Montenegro, one well with 215 m length. In the same period in Medimurje 10,000, and in Bosnia approx 500 tons of crude oil were produced. In the period 1945–55, systematic geophysical and geological explorations of the petroleum areas were carried out, and *ca* 60,000 m of exploration wells drilled with a production of 60,000 tons of crude oil. From 1945 up to the present day systematic exploration work was done in almost all parts of Yugoslavia, and 7236 sq. km. was gravimetrically examined, 110 sq. km. with torsion balance, 646 sq. km. geomagnetically, and 797 sq. km. seismically. Exploration work in Croatia, Slovenia, and Bosnia was particularly intensive. (Author's abstract.)

DRILLING

259. French contribution to the manufacture and control of modern drill pipe. A. Madrelle. *Rev. Inst. franç Pétrole*, 1955, **10** (5), 391–4.—Because of the strenuous working conditions to which drill pipe is subjected API specifications must be considered as a minimum, and manufacturers generally work to more severe specifications. Control and testing are applied at all stages in the manufacture; billets, after drawing, welding, and heat treatment. Tests are made at 80% of the nominal yield strength. Pressure tests are also made at a value corresponding to 80% of the elastic limit for the nominal thickness. Ultrasonic and radiographic inspection is carried out on flash-welded tool joints. The tests are made on each batch, and include alternating flexure testing. G. D. H.

260. Formation sampling speeded by new down-hole tools. K. B. Barnes. *Oil Gas J.*, 12.9.55, **54** (19), 84.—New equipment for taking formation fluid samples is described briefly; the tools which are run on cable can also measure formation pressure on a surface recorder.

The technique is as follows: the tool is lowered in a collapsed position until opposite the formation to be tested; it is then expanded, fixing a pad tightly against the wall of the hole. 2 bullets are fired through the pad, and fluids from the formation can then flow through the perforations and connecting tubes into a one gal reservoir in the tool. C. A. F.

261. Field welding of oilfield tubular goods. J. N. Biron and B. G. Franzier. *J. Petrol. Tech.*, 1955, **7** (9), 29–32.—Tests on several typical samples of field welding of scratcher and centralizer lugs showed the welds to be of inconsistent and generally poor quality. The force required to pull off the lugs or to cause the band of the scratcher to pass over the lugs when forced against them was measured. The welds were examined in the lab.

As the carbon and alloy content increase the welding operation becomes more difficult, and these contents for the cases considered were higher than in most conventional welding. In oilfield work the welding causes drastic changes in the heat-affected area. Failure to follow good welding practices leads to poor quality welds.

It appears that better methods than welding are needed for securing the lower joints and float equipment of casing strings, attaching scratchers and centralizers and their lugs, and securing conductor pipe to the surface pipe. G. D. H.

262. Hydraulic couplings and converters: their application in drilling. R. Larboulette. *Bull. Ass. franç. Tech. Pétrole*, Sept. 1955, (113), 497–518.—The first hydraulic-type coupling was devised by Föttinger in 1910 to reduce the speed of a steam-turbine. The speed was reduced to $\frac{1}{3}$, and the efficiency was 85%. In 1926 Sinclair applied the coupling to buses, and the first application to drilling rigs was in 1948.

The 2 main parts of the coupling are the impeller and the turbine. The coupling is 85–90% filled with light oil. The numbers of vanes are slightly different in impeller and turbine, thereby avoiding simultaneous disturbances at all the vanes when a pair pass each other. Normally the impeller turns a little more rapidly than the turbine, causing circulation of the fluid.

Hydraulic converters have stators in addition to the turbine and impeller. The turbine speed is always less than that of the impeller, and in this case the difference in speed is more important, for the vanes of the stator cause friction and eddy losses not present in the coupling. The efficiency is 85–90%, against 98% for the coupling. The couple transmitted varies as the square of the impeller speed.

The theory of the converter is given and several types of converter are described (Scoop tube, Schneider, Lysholm–Smith). Hydraulic transmission reduces the effects of shocks, and gives more rapid withdrawal of pipe than mechanical transmissions. The converters offer advantages with mud pumps and rotary tables.

Hydraulic couplings make the use of diesels as prime movers much easier. The life of the motor and transmission may be longer with hydraulic transmissions, and the breakdowns of the latter may be no more frequent than with mechanical transmission. G. D. H.

263. Drilling with a subsurface motor and the development of the turbo-drill. W. Tiraspolsky, R. Rouvière, and J. Charé. *Rev. Inst. franç. Pétrole*, 1955, **10** (8), 886–91.—The principles involved in cable tool and conventional rotary drilling are examined, and it is pointed out that the latter allowed more power to be applied to the tool. However, in rotary drilling at considerable depth a large amount of energy is used in turning the drill pipe and the effective power at the bit is relatively low. In order to reduce these high transmission losses the use of subsurface motors was considered, and these could be driven electrically or by moving fluid. A rotary percussion drill was devised, and although the relative advance as compared with pure rotary appears good at low bit pressures, the absolute rate is poor, and the advantage is greatly reduced for bit pressures ensuring reasonable rates of advance.

Electrically driven bits have been used in Russia and the U.S.A., but commercial development has not yet taken place. The Russian device was more efficient than ordinary rotary, while the American form was used for re-drilling and deepening wells.

The development and theory of the turbo-drill are given in considerable detail, and the permissible or necessary changes in other equipment in using it are enumerated. The technique of using the turbo-drill is described, and reference is made to drilling vertical and directional holes, to coring, and to the type of mud needed. To date the turbo-drill has been used only for large dia holes. Outside oilfields it has been used for freezing operations in connexion with shaft sinking. Retractable bits and other devices are being considered for speeding up operations.

Turbo-drilling has been extensively used in Russia, but in the U.S.A. average drilling depths and conditions do not yet seem to have reached a point where the turbo-drill would be definitely superior to the rotary. The position may change when a small dia turbo-drill is developed. The development of a turbo-drill in France is being actively pursued. G. D. H.

264. Turbo-drill in the U.S.S.R. F. A. Trebin. *Bull. Ass. franç. Tech. Pétrole*, Sept. 1955, (113), 481–95.—The first turbo-drill was devised by Kapelyushnikov in 1925, and was used in a limited way until 1934. In 1935 an axial flow turbo-drill was conceived, and this had a speed of 500–900 rev/min with a weight of 30–35 tonnes on the bit. From 1950 to 1954 the efficiency of the turbine was raised from 55 to 70%. However, due to abrasion some parts of the turbine had a working life of only 8–10 hr. The use of rubber of appropriate hardness in these parts has greatly increased the resistance to abrasion by grit particles, and so made the turbo-drill a more practical proposition, for the life of these parts is now 150 hr or more. Turbines involving several stages were first used in 1940, in which year turbo-drills were used on 3% of the wells; in 1954 they were used on *ca* 65% of the wells in the U.S.S.R. The power applied rose from 100 h.p. in 1945 to 450 h.p. in 1954.

In the Tuymazy region, where the formations are hard, an 1800-m well drilled by a modern rotary outfit using tri-cone bits has an average rate of advance of 2 m/hr. However, a turbo-drill with tri-cone bits attains 22 m/hr. A 250-m chert series at Podolsk and Myschkovsky required 30–40 bits for conventional rotary, and only 8–10 bits with a turbo-drill, which gave 25 m/hr advance.

In a zone in eastern U.S.S.R. substitution of turbo-drills for rotary reduced the time per well from 120–150 days to 20–40 days, with the cost per metre *ca* $\frac{1}{2}$ of that for rotary. In the E., water is used as drilling fluid in 70% of the wells. For a time the turbo-drill showed no advantage where the formations were not hard, but adaptation in 1954 gave average drilling rates at Buzovny of 25–40 m/hr, twice the best rate for rotary, while the first 1000 m has been drilled by a single bit in 12–15 hr.

Progress has been made with the development of automatic feed for turbo-drills. Deviated holes can be drilled readily, and arrangements have been made for drilling twin holes from one derrick, the tools being used alternately in the 2 holes, with auxiliary work being executed on the hole in which drilling was not currently proceeding. In addition, multiple holes have been drilled obliquely into the producing formation from a single well. A bit has been devised which can be recovered with an overshot, and replaced without pulling the drill pipe. *Ca* $\frac{1}{2}$ hr was needed to change a bit at 1000 m. G. D. H.

265. Turbo-drill in the U.S.S.R. F. A. Trebin. *Rev. Inst. franç. Pétrole*, 1955, **10** (8), 876–85.—*Cf.* Abs. **264**, 1956.

PRODUCTION

266. Exploration drilling and production of crude oil since 1945. V. Bobula. *Nafta* (*Yugoslavia*), 1955, **6** (8), 249–57.—The paper gives a brief description of the state of the crude-bearing areas after the second world war, and the problems of drilling and production. The history of crude oil production in the republics of Croatia and Slovenia, and of exploration drilling in the rest of the republics is related. Details of the difficulties encountered and forms of organization the petroleum industry had to go through in this period are described. Data on the available drilling rigs and actually effected drilling lengths are given by years and republics. In the last 10 years the following numbers of production wells and drilling lengths were obtained: Croatia, 255 wells, 232,638 m; Slovenia, 119 wells, 192,555 m; Serbia, 58 wells, 63,147 m; Bosnia 7 wells, 8477 m; Montenegro, 8 wells, 13,026 m. The total production of crude oil in Yugoslavia was: 1945, 31,392 tons; 1946, 28,835 tons; 1947, 33,245 tons; 1948, 36,498 tons; 1949, 63,240 tons; 1950, 110,343 tons; 1951, 148,133 tons; 1952, 151,537 tons; 1953, 171,707 tons; 1954, 216,272 tons.
(Author's abstract.)

267. Scaling laws for use in design and operation of water–oil flow models. L. A. Rapoport. *J. Petrol. Tech.*, 1955, **7** (9), AIMME Tech. Paper No. 4121, 143–50.—A mathematical formulation is given of incompressible 2-phase flow phenomena in a 3-dimensional porous medium. Note is taken of the effects of gravitational and capillary forces in the formula-

tion, and the resultant equations are used to derive general scaling laws for representing accurately water–oil displacement processes by means of flow studies on models. The relationships are compared with those obtained by others by dimensional methods. The laws are also examined with regard to their significance in the light of the physics of the behaviour of fluids in porous media.

The application and limitation of flow model studies in connexion with reservoir problems are discussed. It may be necessary to make model tests with 2 or 3 different materials, corresponding to different limiting types of permeability and capillary pressure relationships, thereby permitting the study of the water–oil flow processes for a wide range of reservoir conditions. Fitting or interpolation to match the characteristics of a given reservoir would permit its behaviour to be predicted. G. D. H.

268. Isochronal performance method of determining the flow characteristics of gas wells. M. H. Cullender. *J. Petrol. Tech.*, 1955, **7** (9), AIMME Tech. Paper No. 4120, 137–42.—Gas wells producing from low permeability reservoirs stabilize slowly, and problems arise in trying to determine their true performance characteristics. This is because of an interrelation between C and n in the conventional back-pressure equation :

$$Q = C(P_f^2 - P_s^2)^n$$

An empirical method is given for obtaining the characteristic or true slope (n) of the back-pressure curve of a gas well. The test data are obtained at known times after opening up after the well has been shut in, no adjustments being made. The well is closed in and allowed to return to a condition comparable with that when the well was opened. It is then reopened at a different rate and further data are obtained. This is repeated as often as is needed to get the necessary data. Plots of Q and $P_f^2 - P_s^2$ for constant times on logarithmic paper give parallel lines of which the slope is n. This slope can be obtained at short time intervals after the well is opened, probably because the bulk of the pressure drop is near the well. The performance coeff of a well is controlled by the extent of the drainage area and the pressure gradient within that area. For a simple pressure it is variable with time. G. D. H.

269. Case history of reservoir performance of a highly volatile type oil reservoir. R. W. Woods. *J. Petrol. Tech.*, 1955, **7** (10), AIMME Tech. Paper No. 412C, 156–9.—The structure is a dome with dips of 3°–4°, and the reservoir considered is 8200 ft deep. The oil sand thickness averages 22 ft. The oil column is 339 ft high, and the producing area is *ca* 8900 acres with an average net sand thickness of 12 ft. 10 wells have been completed in the reservoir, and initial rates ranged 800–1000 b.d. Cumulative production was 10,880,000 brl at the end of March 1954, with 95,000,000 M.c.f. gas and 250,000 brl water. Spacing is triangular, giving *ca* 308 acres/well. Average porosity is 19·8% and permeability *ca* 750 mD. Interstitial water is 25%. Saturation pressure is estimated to have been 3940 p.s.i.g., with formation volume factor 3·23 and dissolved G.O.R. 3180. The original pressure is estimated to have been *ca* 5000 p.s.i., and the pressure has dropped to 1450 p.s.i. Initially the oil produced was 43°–44·5° API with a G.O.R. of 3000–3200. 2,500,000 brl of oil was recovered while the fluid was undersaturated, and afterwards there was a continuous rise in producing G.O.R. and API oil gravity, the later values being 23,000 and 62°, respectively. It seems that in the later phases only part of the liq recovery is by liq flow in the reservoir. Initial oil in place is calculated to be *ca* 50,000,000 brl by material balance, and 40,000,000 brl volumetrically. Expansion of liq has accounted for the recovery of *ca* 5% of initial oil in place. As the pressure has declined, the proportion of light hydrocarbons produced has increased, making the liq phase remaining in the reservoir richer in heavy hydrocarbons. G. D. H.

270. Material balances in expansion type reservoirs above bubble point. M. F. Hawkins. *J. Petrol. Tech.*, 1955, **7** (10), 49–52.—The compressibility of rock may be a significant factor in production above the bubble point. Interstitial water will also expand with pressure decline. Allowing for these factors the initial oil in place is given approx by :

$$N = \frac{(1 - S_w)\,N_p}{[C_f + C_o - S_w(C_o - C_w)]\,\Delta p}$$

where C_o is oil compressibility, C_w water compressibility, C_f formation compressibility (pore vol/unit pore vol/p.s.i.), S_w is interstitial water (fraction), N_p is cumulative oil production, and Δp is the pressure drop.

Data are given on the compressibility of hydrocarbon liq, the solubility of natural gas in water and brine, the compressibility of water and the effect of dissolved gas on this, and on the effective formation compressibility.

An example is presented in which allowance is made for formation compressibility. Failure to allow for the effects discussed leads to over-estimation of the oil reserves. G. D. H.

271. Single-fluid five-spot floods in dipping reservoirs. M. Prats, W. R. Strickler, and C. S. Matthews. *J. Petrol. Tech.*, 1955, **7** (10), AIMME Tech. Paper No. 4127, 160–74.—Most past water-floods have been in reservoirs with gentle dip, and so there are no field data on the effects of dip on the performance characteristics for floods. A mathematical study has been made for single-fluid 5-spot floods in dipping reservoirs. The cases considered are those with the maintenance of a uniform sand-face pressure at all injection wells and a lower uniform sand-face pressure at all producers, and the maintenance of a constant head in all injection wells with a uniform sand-face pressure for all producers. In the first case symmetrical and asymmetrical patterns were investigated. Diagrams show the streamlines for the various cases, and curves give the relationship between sweep efficiency at water break-through and the ratio of gravity head to potential difference between high up-dip injection well and low down-dip production well of the same 5-spot system. Sweep efficiency diminishes with increase in this ratio. Displacement of the producing well up-dip improved the sweep efficiency.

An approx study of the 2-fluid case is outlined. G. D. H.

272. Elements of fluid mechanics in porous media. A. Houpeurt. *Rev. Inst. franç. Pétrole*, 1955, **10** (8), 912–28.—First the rate of flow and the cumulative production are derived for a semi-infinite system initially in pressure equilibrium, and for which the pressure at the outlet is dropped to, and maintained at, a lower pressure. The pressure behaviour is examined for a comparable system in which the rate of flow from the outlet is kept constant. Next the problems of instantaneous and continuous point sources are investigated, and in addition the pressure build-ups after phases of flow with a constant outlet pressure, or fixed rate of flow are studied. The application of Duhamel's theorem is considered. G. D. H.

273. Interfacial activities and porphyrin contents of oil-shale extracts. J. W. Moore and H. N. Dunning. *Industr. Engng Chem.*, 1955, **47** (7), 1440–4.—The wettability of reservoir surfaces influences the flow and distribution of fluids in the reservoir and may determine whether petroleum can be produced economically. Previous studies have shown that interfacial activity of extracts of a Californian crude oil can be correlated with its porphyrin and nitrogen content. The high nitrogen and porphyrin content of oil shale led to an analysis of the interfacial tension–porphyrin content relationship. A Colorado oil-shale sample was successively extracted with solvents of increasing polarity and the total nitrogen, porphyrin, iron, nickel, vanadium, and copper contents of the extract were determined. The interfacial activity could in most cases be correlated with the nitrogen and porphyrin contents. B. A. F.

274. Variables in the centrifugal testing of petroleum displacement by detergent solutions. H. N. Dunning *et al.* *Industr. Engng Chem.*, 1955, **47** (10), 2147–52.—The possibility of in-

creasing the yield of oil from water-flooded fields by the use of surface-active agents has necessitated the development of a rapid method of determining the efficiency of displacement of oil from sand–oil mixtures by detergent soln. 4 sand samples, 4 crude oils, and 3 series comprising 22 non-ionic polyoxethylated detergents were used in studying the variables in the centrifugal method of testing. The studies indicate that temp, contact period, method of sample preparation, and crude oil composition are not important variables. The sensitivity of the test can be adjusted by varying oil saturation, sand particle size, centrifugal force, and violence of agitation. B. A. F.

275. Estimating size and shape of vertical and horizontal fractures. P. B. Crawford, A. C. England, B. L. Landrum, and W. F. Haney. *J. Petrol. Tech.*, 1955, **7** (10), AIMME Tech. Paper No. 4128, 175–81.—A knowledge of the shape and size of induced fractures may be important in planning water-flooding or gas-cycling. Sometimes information on orientation is needed. For study an electrical model was used, with the vertical fractures simulated by copper strip soldered to a wire representing the well. 4 unfractured wells were located at known distances from the central fractured well. The fractures varied in length and orientation, and isopotential lines were plotted with the observation wells in 4 different positions attained by rotation. Diagrams show isopotentials, and tables give data for estimating vertical fracture orientation from draw-down data.

In practice the 4 wells round the commercially fractured well are shut in, and the latter is produced until substantially steady-state conditions exist, and then the shut-in bottom-hole pressures of the 4 wells are noted. The pressures are made dimensionless by dividing by the largest pressure, and the 3 values less than unity in the order of the well placings are located on the tabulation as relative drawn-downs, and by that means the fracture pattern is recognized. The actual fractures and pattern are equivalent and not necessarily identical.

A similar procedure using appropriate tabulations can be used for bedding plane fractures. G. D. H.

276. New apparatus for studying pressure-induced fracturing in reference to lost circulation. A. J. Teplitz, E. M. Pohoriles, and J. K. Rodgers. *J. Petrol. Tech.*, 1955, **7** (9), 77–9.—The use of instruments capable of detecting the points of fluid loss in wells with considerable accuracy has suggested that in some cases the loss is taking place in an interval of less than 1 ft, and is in horizontal fractures. The formation of such fractures may be influenced by borehole irregularities. Apparatus for studying this feature is described. The test cell is in 2 flanged parts held together by a spring, the load on which can be adjusted. The inner edges of the flanges are bevelled to simulate borehole irregularity. Actual cores could also be cemented in the apparatus instead of the bevelled flanges, the cores being drilled out to give the recesses thought to be needed for horizontal rupture. This equipment in both forms gave partings which conformed more closely with field observations than did tests where the borehole was flush.

It appears that of non-time-setting sealing agents hard granular materials are most effective for stopping losses, and sealing occurs in the recess rather than in the fracture. The stopping of losses may be most efficient with a concentrated mass of sufficient hardness and impermeability to prevent vertical components of the hydraulic forces being transmitted to the formation. G. D. H.

277. Super sleuths trace flow of injected gas. H. J. Welge. *Oil Gas J.*, 29.8.55, **54** (17), 77.—Field tests in part of Cromwell field in central Oklahoma have shown that the direction of flow of injected gas can be satisfactorily followed with the aid of radio-active tracers. The tracers used are described.

The max theoretical time of travel of gas from a central injection well to the producing wells is defined as the gas-occupied pore volume in the area divided by the gas injection rate, and this time of travel was found to be 11 days. The test area comprised a central injection well surrounded by 7 producing wells, all on a square 10-acre spacing pattern. C. A. F.

278. Two errors in pressure measurement using subsurface gauges. W. J. Ainsworth and M. F. Hawkins. *J. Petrol. Tech.*, 1955, **7** (9), 80.—The extension of the pressure sensitive element in a subsurface gauge depends on the difference between the pressure inside the gauge and that outside. The internal pressure is near atmospheric and is determined by the quantity of air sealed inside at the time of calibration and on the water content of that air. When the air is sealed in the gauge at the same temp and pressure for both the calibration and the well measurement, the usual temp correction caters for differences between calibration and well measurement temp. Otherwise an additional correction is needed, and this depends on the temp and pressures obtaining on the 2 occasions of sealing. The presence of moisture will cause another error, and so it is wisest to exclude water vapour and always to seal the gauge at near calibration conditions. G. D. H.

279. Theoretical and practical aspects of free piston operation. J. M. Lebeaux and L. F. Sudduth. *J. Petrol. Tech.*, 1955, **7** (9), 33–7.—The principles involved in the operation of the free piston, and some features of its construction and operation are described. It can be successfully applied only under certain conditions and in certain types of wells, and with proper selection of the length of operating cycle. A 2-inch piston can give 70 b.d. from a max depth of 8000 ft. Installation may cost $1000. It may prevent paraffin deposition, and is somewhat more effective than stop-cocking.

The results of using free pistons in a number of different areas are described, and the theoretical and actual gas lift requirements are compared in some cases. A nomogram affords a means of linking flowing B.H.P., gas–fluid ratio, flowing surface pressure, and working fluid level. G. D. H.

280. Studies of the mechanism of paraffin deposition and its control. D. A. Shock, J. D. Sudbury, and J. J. Crockett. *J. Petrol. Tech.*, 1955, **7** (9), 23–8.—A study of the literature shows that so-called paraffin deposition causes troubles in a number of areas in the U.S.A., and that various types of crude oil are involved. The deposits vary in composition and the components range from high mol. wt. normal hydrocarbons to asphalts and resins. Their solubilities are related to their composition, and those with much asphaltic matter do not dissolve well in the usual commercial solvents. A method of determining the solubility rating is described. The temp–visc curve seems to afford a measure of the paraffin deposition tendency, and reveals differences according to whether the deposits are waxy, involve colloidal asphaltic bodies, or viscous water–oil emulsions.

The rate of deposit formation is important, and agents which reduce the rate may be of value. Other factors which influence deposition are discussed: temp, nature of surface, gas bubbles, and other nuclei. Methods of paraffin control are enumerated. G. D. H.

281. Solubility studies on high molecular weight paraffin hydrocarbons obtained from petroleum rod waxes. C. C. Nathan. *J. Petrol. Tech.*, 1955, **7** (9), AIMME Tech. Paper No. 4122, 151–5.—Data on the physical properties of waxes obtained from 5 fields in Texas and Louisiana are given, the waxes having been fractionated into components soluble in cold acetone, soluble in boiling acetone, and insoluble in boiling acetone. The last fraction consisted mainly of straight-chain paraffins of mol. wt. 525–700. It was found that the solubilities of the purified high mol. wt. paraffins in hydrocarbon solvents, including crude oil, could be calculated satisfactorily by ideal solubility relationships. Chlorinated and oxygenated solvents did not obey these relationships, the former giving values ranging from 5 times to $\frac{1}{100}$ of the theoretical. CS_2 was the best solvent, while oxygenated solvents were very poor. The deviations can be partially correlated with the internal pressure of the solvents. Solubility in heptane approached ideal behaviour.

The heats and entropies of fusion of the waxes were also investigated. G. D. H.

282. Note on the destruction of petroleum by micro-organisms. J. Appert and M. Louis. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 345–8.—In the presence of water under favourable conditions almost all types of hydrocarbons can be attacked by micro-organisms. The most extensive attack is by aerobic bacteria. The order of preferential attack is paraffins, benzenes, naphthenes. Tausz found bacteria to increase the asphalt content of Mendoza crude, while Imelik, using soil bacteria and gas oil, noted increase in naphthenic acids, density of aromatic-fraction and bromine No., lowering of the b.p. of the paraffin fraction, and a considerable reduction in the amount of cyclic cpds.

In new work water and mud from Lake Enghien were put with the dist residue of Kuwait crude. Sulphates and a variety of micro-organisms were present, and the material was examined at intervals of *ca* 30 days. The oil showed at first an increase in resins and a drop in oily constituents, without a change in asphaltenes. Later the amounts of asphalts and resins fell. There were gaseous products.

There is evidence of cyclic cpds being attacked during the phase of resin formation. This resembles the effects of oxidn in air. The phase of asphaltene formation is similar but different in degree. G. D. H.

OILFIELD DEVELOPMENT

283. Deep drilling outlines major field at Sherman. N. S. Morrisey. *Oil Gas J.*, 22.8.55, **54** (16), 118.—Development of the Sherman field in Grayson County, Texas, is outlined. The field is situated on an anticline 10 miles long and *ca* 3 miles wide, and numerous pays have been found between 3000 and 12,000 ft in Pennsylvanian and Ordovician sands and limestones.

A major reverse fault parallels the crest of the anticline trending NW. to SE., and there is a major unconformity separating the Pennsylvanian and Ordovician. C. A. F.

284. Magnolia sets record. R. J. Enright. *Oil Gas J.*, 29.8.55, **54** (17), 56.—Drilling operations of the West Ranch 417A well in Jackson County, Texas, are outlined; this is the deepest well in Texas, drilled to explore a deep-seated salt dome. Total depth is below 19,000 ft, and Vicksburg and Jackson shales have been penetrated from 7500 ft to present depth. Bottom hole temp is over 380° F with a gradient averaging 3°/100 ft.

A new calcium surfactant drilling mud has been used to combat high temp and pressure and caving shale, and it has been possible to maintain a fast rate of drilling.

Casing and cementation data are included. C. A. F.

285. Joffre's oil is high quality, but its wells are deep, its pay section thin. M. Love. *Oil Gas J.*, 5.9.55, **54** (18), 164.—The geology and development of the Joffre field, near Red Deer, Alberta, are outlined. The field produces oil from the Cretaceous Viking, and 89 producers had been completed to April 1955, with 4800 acres proved and 1000 acres semi-proved; the discovery well was completed in 1953.

The Viking zone is *ca* 90 ft thick, consisting of one to 3 porous sands bedded between tight sandy shales; porosity of the pays averages only 13%, with average horizontal permeability of 190 mD. Up to 3 pays may be present in any one well, but they may be part of one reservoir. Control is thought to be due to eastern pinchout.

Average initial potentials vary considerably, and wells with a thin pay have been sandfraced.

Estimated recoverable reserves are 8,900,000 brl. C. A. F.

286. Field Report: Canada's Sturgeon Lake area. R. G. Humphries and C. O. Hago. *Oil Gas J.*, 19.9.55, **54** (20), 171.—The geology, development, and reservoir characteristics of the 3 fields comprising the Sturgeon Lake area in NW. Alberta are described.

The fields are Sturgeon Lake, Sturgeon Lake South, and Little Smoky; all are Devonian reef accumulations, and the discovery well at Sturgeon Lake was completed at *ca* 9000 ft in 1952. 26 producers have been completed in the fields, and they are estimated to be *ca* 8% developed; it is uncertain whether the Sturgeon fields are parts of one continuous field, but Little Smoky is separate, having an oil–water contact 150 ft below that in the S. field.

Reservoir data are given for each of the fields, and recoverable oil reserves for the group (Stock tank brl) are estimated at 177,438,000 brl.

A structural map and cross-section are included. C. A. F.

287. Pembina now Canada's second-biggest producer; reserves are largest. H. E. Parsons. *Oil Gas J.*, 15.8.55, **54** (15), 120.—The geology and development of the Pembina field in Alberta are described. Pembina field is 72 miles SW. of Edmonton, and was discovered in 1953 with upper Cretaceous Cardium pay. 380 wells have since been completed as producers, and the productive acreage is greater than any other field known in the W. Hemisphere; production is over 49,000 b.d.

Pay is marine sandstone ranging up to 25 ft thick, dipping westwards at 30–60 ft/mile. There is no local structure, and the accumulation is controlled by seaward "shale out" and permeability change. Depth to the pay ranges from 4600 ft, near the up-dip edge, to 5800 ft, in the SW. sector. Porosity averages *ca* 16%, and estimated recovery/acre ranges from 1000 to 4000 brl.

Drilling and completion programmes are briefly outlined, and electric log cross-sections and maps of the area are included. C. A. F.

288. Parentis test Europe's first offshore well. Anon. *Oil Gas J.*, 22.8.55, **54** (16), 108.—An offshore well is being drilled in the Lake of Biscarrosse adjacent to the Parentis field in SW. France. The well is believed to be on the same structure as Parentis, which is now producing 13,000 b.d. from 7 wells.

This is the first offshore well to be drilled in Europe. C. A. F.

TRANSPORT AND STORAGE

289. Audio signal announces interface arrival. F. L. Resen. *Oil Gas J.*, 7.11.55, **54** (27), 104.—By means of an alarm system an externally mounted radiation device measures specific gravity of an incoming natural gasoline–*iso*butane stream at Cosden's Big Spring, Texas, refinery. G. A. C.

290. Closed vapor system cuts vapor losses. F. L. Resen. *Oil Gas J.*, 7.11.55, **54** (27), 100.—A Horton vapour tank equipped with a flexible membrane tied in with all of the light products storage tanks is used by Delhi–Taylor at the Corpus Christi, Texas, refinery. G. A. C.

291. LP-gas underground storage. N. E. van Fossan. *Proc. nat. Gas. Ass. Amer.*, 34*th ann. Conv.*, 1955, 80–93.—This paper is primarily devoted to the washed type soln cavern developed in salt formations. The selection of the location for such a unit and of the procedures necessary to develop it are of primary importance, for the best containing media is useless when the geographical location is unsuited to production, export staging, or marketing.

When a desirable location has been established and media located that will be impervious to the passage of the product to be stored, it must be further established that no contaminants, which are not capable of economic removal, are contained therein. The over-burden should be capable of withstanding static pressures in excess of the contained or operating pressures of the cavity, and the capping formations should

permit washing procedures. A plentiful supply of water is also desirable, and facilities available for the disposal of brine.

What appears to be the most logical theory of salt deposition is discussed; and drilling, cementing, and washing procedures are described. A summary of past, present, and future underground storage developments is given. 6 figs. M. P. T.

292. Aerial surveys and mapping. P. J. Gibbs. *Pipe Line News*, 1955, **27** (8), 34–9.—Used in conjunction with the correct measuring instruments, aerial photographs can furnish accurate and complete data necessary for determining the best route available to pipeline systems. B. A. F.

293. Compressor plant acoustics. R. C. Baird. *Pipe Line News*, 1955, **27** (7), 32–8.—The problem of noise from compressor stations is connected mainly with the compressors, although there is some noise from auxiliaries. The problem is not one of the intensity of noise alone, and a periodic variation in noise can be annoying even at low intensities. Resonance is important, and may lead to equipment being transparent to certain frequencies. The containing of engine room noise is possible by the use of tightly bonded buildings of high density brick which is opaque to sound. This gives rise to the problem of preventing the increase of engine room noise. Acoustical absorbing material, correctly placed, is effective in controlling noise, but operating difficulties prevent the complete screening of plant with absorbing material. The effect of terrain and weather on the transmission of noise make the assessing of noise in any place indeterminate. B. A. F.

294. Hydraulics for pipeliners. Pt X. C. B. Lester. *Pipe Line News*, 1955, **27** (5), 40–4. The formulæ for radial, tangential, and longitudinal stresses are developed for round pipe. The magnitude of the effects of out of round pipe, flat spots, soil stresses, and support stresses (for lines above ground) are evaluated. B. A. F.

295. Internal cleaning of pipelines in operation. P. L. Hughen. *Pipe Line News*, 1955, **27** (8), 27–31.—The efficiency of pipeline operation can be maintained by regular scraper programmes. Analysis of data shows that long sections of pipe are difficult to clean and that the amount of foreign matter removed from the pipe cannot be taken as an indication of the effectiveness of scraper runs. It was not found possible to correlate the number of scraper runs with the ensuing increase in efficiency, but there is an economical number of runs. Time and labour costs can be reduced by running trains of scrapers. B. A. F.

296. The Badger pipeline. E. Sterrett. *Pipe Line News*, 1955, **27** (7), 18–26.—The 267-mile products pipeline from East Chicago, Indiana, and Peru, Illinois, to Madison, Wisconsin, permits the movement of petroleum products through the congested areas of Chicago. A description of the construction and operation of this line, handling 60,000 b.d., is given. B. A. F.

297. Engineering for pipeline crossings. L. M. Odom. *Pipe Line News*, 1955, **27** (8), 40–1.—The selection of the site, design considerations, installation procedure, selection of season, and the inspection and testing of underwater crossing are reviewed. B. A. F.

298. How to empty a pipeline. S. C. Phelps. *Oil Gas J.*, 7.11.55, **54** (27), 116.—Current practices are described in the removal of crude line fill, and good and bad points of methods are reviewed. G. A. C.

299. Remotely controlled, unattended pump stations. T. V. Bockman and R. S. Cannon. *Pipe Line News*, 1955, **27** (7), 39–44.—Safety conditions dictate the type of lay-out and equipment used on unattended pumping stations. It is recommended that only the best equipment should be used and that it should be carefully inspected before installation. The choice between microwave and telephone systems of control depend greatly on local circumstances, and a general solution cannot be given. Maintenance is very important, and an intensive training programme for maintenance personnel is recommended. B. A. F.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

300. 10 years of petroleum refining in Yugoslavia. V. Boranic. *Nafta* (*Yugoslavia*), 1955, **6** (8), 257–61.—The paper gives a short history of Yugoslav refineries before the second world war, their capacities and quantities of produced derivatives. The situation of the refineries after reconstruction and enlargement carried out after the war is represented with more details, and quantities of processed crudes are specified by origin. The Yugoslav refineries processed a total of 200,000 tons of crude p.a. before the second world war, only 135,000 tons in 1948, and *ca* 665,000 tons in 1948. In the total of processed crude oil, domestic crudes include *ca* 30%, the rest being imported principally from the Near East. The average yields are 20% gasoline, 7% kerosine, 23% gas oils, 5% lub oils, 33% fuel oil, 9% bitumen, the remaining 3% covering loss and miscellaneous products. The refineries are covering 90% of the country's requirements, and some surplus articles are exported. All the products correspond to international specifications. (Author's abstract.)

301. Equipment for oil and petrochemical process development. H. Hoog *et al.* *Industr. Engng Chem.*, 1955, **47** (6), 1104–16. In this description of the process development and pilot plant sections of the Royal Dutch Shell laboratories at Amsterdam, the emphasis is on the types and sizes of equipment. B. A. F.

DISTILLATION

302. Improved integral technique for petroleum distillation calculations. W. C. Edmister. *Industr. Engng Chem.*, 1955, **47** (9), 1685–90.—The summation of K values for mixtures of a finite number of components is replaced by a graphical integration method for mixtures of an indefinite number of components. The principles are illustrated by 3 samples, equilibrium flash vaporization, bubble and dew points, and fractional dist. B. A. F.

303. Fractionating efficiency of coke packings. F. Yoshida and T. Koyanagi. *Industr. Engng Chem.*, 1955, **47** (4), 711–14.—The performance of coke packings in dist columns operated at atm pressure and total reflux were evaluated using ethyl alcohol–water and benzene–ethylene dichloride mixtures. The H.E.T.P. values recorded for medium-sized coke were considerably lower than for Raschig rings of the same size, but values for small-size coke were comparable with values for single-turn helices. The pressure drop/theoretical plate was roughly equal to that for conventional packings, but the liq hold-up was greater with coke packing. B. A. F.

ABSORPTION AND ADSORPTION

304. Comparison of perforated plates with bubble cap trays in absorber service. R. E. Kelley. *Proc. nat. Gas. Ass. Amer.*, *34th ann. Conv.*, 1955, 39–44.—The results of a series of plant tests conducted on 2 parallel absorbers, one equipped with perforated trays and the other with bubble cap trays, are presented. Both absorbers are operated at 65 p.s.i.g. and 90° F lean oil temp to recover propanes, butanes, and heavier components from various high-pressure gas streams.

The conclusions reached are that perforated trays are entirely satisfactory for service in absorbers in so far as capacity and efficiency are concerned. Good fouling characteristics have been demonstrated in a relatively clean service. It is esti-

mated that the single-pass perforated tray with blanking strips removed would have essentially the same capacity as a 4-pass bubble cap tray. Owing to improved methods for calculating hole pressure drop, it should be much easier to design a perforated tray with adequate flexibility than an equivalent bubble cap tray. 5 tables, 3 figs, 7 refs. M. P. T.

305. Effect of number of actual trays on absorpter performance. F. K. Kennedy III and J. N. Chancellor, Jr. *Proc. nat. Gas. Ass. Amer., 34th ann. Conv.*, 1955, 36–8.—A series of tests run on an absorber in a gasoline plant has indicated that the number of theoretical plates does not increase proportionally with an increase in actual trays in the range of 20–40 trays. Overall tray efficiency, with respect to all components, declines markedly with an increase in actual trays. The use of an overall average tray efficiency for all components is questioned, since the test results show a significent trend towards lower tray efficiencies with respect to individual components as volatility increases from the butanes through methane. 4 tables, 1 fig, 5 refs. (Authors' abstract.)

306. A progress report of tray efficiency studies. B. Williams and L. A. Warzel. *Proc. nat. Gas. Ass. Amer., 34th ann. Conv.*, 1955, 30–5.—The various definitions of tray efficiency are briefly summarized. The prediction of tray efficiency by the method of combining individual phase resistances is described and applied to the operating and design conditions of an absorber. It is suggested that design for good tray efficiency is as important as design for capacity but that the former is seldom considered in design. A good design should be based upon both considerations, but mass transfer rates are not as well understood as capacities. Current co-operative research should add much to our knowledge in the next few years. 5 figs, 3 tables, 50 refs. (Authors' abstract.)

SOLVENT EXTRACTION AND DEWAXING

307. Rotating disk contactor. G. H. Reman and J. G. van de Vusse. *Chim. et Industr.* (*Génie Chim.* suppl.), 1955, **74**, 106–14.—Description and sketch of liq–liq contactor consisting of vertical cyl divided into compartments by horizontal plates through which disk-fitted rotating shaft passes coaxially. Extraction is counter-current, heavier liq entering at top; either liq can be continuous phase. Effect of various factors on throughput and efficiency are considered. Former is lowered and latter raised by increasing rotation speed or rotor disk dia. Optimum ratio stator opening dia/column dia and dia disk/dia column is in both cases *ca* 0·7. Column dia has little effect. Lab results are applicable to design of full-scale plant. Uses in petroleum industry include water washing of kerosine, furfural extraction of lubes, and solutizer treatment of gasoline. Latter 2 cases are considered in some detail: for furfural extraction (equivalent to 7-stage) cost of plant and of operation is very much in favour of RDC compared to packed col. Graph is given for energy requirements of RDC. V. B.

CRACKING

308. Catalyst activity in cracking of pure hydrocarbons. D. E. Nicholson. *Industr. Engng Chem.*, 1955, **47** (6), 1216–18.—Cat activity has been widely assessed by the products of cracking a standard gas oil at 450° C. In order to provide a reproducible sample stock and to give products that could be analysed by mass spectral methods, the activity of a number of widely varying silica–alumina cat was assessed on *iso*butane and *n*-butane. The products of cracking were analysed in a mass spectrometer. A good correlation was obtained between the rate of cracking in a fixed-bed system and the rate of cracking of a standard gas oil in a flow system under different conditions. The method appears to be useful for comparing activities of various cat. B. A. F.

309. Catalytic processing of gasoline fractions. Various. *Industr. Engng Chem.*, 1955, **47** (4), 719–73.—The 10 papers presented in this symposium deal mainly with the reactions involved in the cat treatment of naphtha fractions. The effect of operating variables in processes such as hydroforming, Platforming, Houdriforming, etc., are dealt with. B. A. F.

310. Effect of residual coke on behaviour of cracking catalyst. A. C. Whitaker and A. D. Kinzer. *Industr. Engng Chem.*, 1955, **47** (10), 2153–7.—The performance of cat in bench scale apparatus often leads to results not borne out in commercial fluid-bed cat crackers, due to inability to reproduce the high cat–oil ratios and short contact times used in practice. A bench scale, fixed cat bed apparatus gave a linear correlation between both carbon yield and conversion when plotted against duration of cracking on log–log paper. This permitted extrapolation of data to conditions comparable with those found in fluid-bed cracking operations. With incompletely regenerated cat, the residual layer of coke gave protection against deactivation by steam, H_2S, and metal cat poisons. B. A. F.

311. Radiotracer study of coke formation on cracking catalyst. R. E. McMahon. *Industr. Engng Chem.*, 1955, **47** (4), 844–5.—*n*-Heptane, *n*-octane, and 1-octene were synthesized having a C^{14} radio-active carbon atom in their structure. The vapours were passed over commercial silica–alumina microsphere cat and the coke deposits analysed for radio-activity. Results indicated that there was no alteration of radio-activity between the coke and the original feed, and it was deduced that all the carbon atoms are equally involved in the mechanism of coke formation. B. A. F.

POLYMERIZATION

312. On the vinyl chloride polymerization. VI. Polymerization in methanol. F. Danusso and F. Sabbioni. *Chim. e Industr.*, 1955, **37** (13), 1032–4.—The vinyl chloride polymerization in methanol (which dissolves the monomer and not the polymer) occurs in heterogeneous phase and is similar to the bulk polymerization. The order of reaction is 1 with respect to the monomer and 0·7 with respect to the initiator, in the range of concn investigated. The relatively high order with respect to the initiator suggests that the solvent is involved in the mechanism of the reaction. First order relative to the monomer must be a more general one, and allows a more detailed specification of kinetic expressions, than was previously possible for vinyl chloride. (Authors' abstract.)

CHEMICAL AND PHYSICAL REFINING

313. Correlation and practical application of results from laboratory and practice. J. Recovery of crude benzene. W. Mantel and H. Hansen. *BrennstChemie*, 1955, **36** (21–22), 328–38.—Absorption in the binary system benzene–wash oil is illustrated and the true relations in the operation characterized. The basic transition principles in counterflow scrubbers are compiled. Dependence of the sorption yields on concn of pure benzene in both phases, on the physical parameters, pressure, temp, mol. wt. of the wash oil, and on the operationally-conditioned quantity of circulating oil and the number of the transition units or the No. of plates is represented. The applicability of Henry's law for the partial pressure of the pure benzene over its soln in wash oils is inferred from measurements of numerous authors published earlier, verified by some measurements and confirmed for benzene homologues. 11 literature refs. R. T.

314. The natural gasoline producers' stake in chemical manufacturing. L. O. Crockett and R. C. Widgery. *Proc. nat. Gas. Ass. Amer., 34th ann. Conv.*, 1955, 46–54.—The paper illustrates the advantages to be derived by the natural gasoline and LPG producer in supplying large volumes of specific close-cut fractions to chemical manufacturers. The market varies little from month to month—thus, the installation of a products pipeline, in order to eliminate expensive road or rail transport, is worth early consideration.

In this way, the natural gasoline producer will obtain a higher return on investment, a reduction of storage problems, and an increase in the proportion of flat-load sales. As a long-term policy, he will become established in the field in which natural gas liq will find their principal use after they have become uncompetitive for many fuel markets.

Some of the more important chemical derivatives of natural gas and natural gas liq are discussed, especially methane, ethane–propane, ethylene, propylene, the butanes, and the remaining products from natural gasoline, and examples are given of the increasing number of chemicals which are produced from them. 6 figs, 1 table, 11 refs. M. P. T.

SPECIAL PROCESSES

315. Carboxylic acid synthesis from olefins, carbon monoxide, and water. H. Koch. *BrennstChemie*, 1955, **36** (21–22), 321–8.—A new process for carboxylic acid synthesis is characterized by mild reaction conditions, *e.g.* low temp (*ca* 0°–30°), and relatively low pressure (20–30 atm). Suitable cat are conc H_2SO_4 (90%) and acid mixtures containing BF_3 in complex combination, with H_2SO_4 or H_3PO_4. No H_2O may be added in the first reaction stage; the cat must be highly conc, H_2O-free. The carboxylic acids obtained—yield generally good—have a branched C-chain, with single or double branching at the C-atom adjacent to the carboxyl group. Suitable raw materials are C_3H_6, C_4H_8 from the cracking process, long-chain olefins of high b.p.-cracked dist, and cyclic olefins. Polymerization products of the tetrameric propylene type or di- and tri-*iso*butylene react smoothly. Oleic acid gives a good yield of C_{19}-dicarboxylic acid. Good yields of carboxylic acids are obtained without pressure apparatus by intensive agitation of the olefin, H·COOH and conc H_2SO_4. 9 literature refs. R. T.

316. Upgrading Fischer–Tropsch products. M. D. Schlesinger. *Industr. Engng Chem.*, 1955, **47** (10), 2104–8.—Synthetic gasoline may be treated over bauxite in a similar manner to petroleum products. Improved octane rating is accomplished by internal rearrangement of the olefin bond, mild cracking, and the reduction of oxygenated cpds to the corresponding hydrocarbon. Treatment of the naphtha fraction of a synthetic oil resulted in an increase of 16·6 in the motor octane rating and an increase in the bromine No. from 70·8 to 128·5. Blending of the synthetic gasoline with polymer gasoline and the addition of 3 ml/gal of TEL yielded a product with an octane rating of 86·8. B. A. F.

317. Fractionation of mixed aromatics from Udex extraction. E. R. Fenske and D. B. Broughton. *Industr. Engng Chem.*, 1955, **47** (4), 714–17.—Thorough investigation of the operating variables resulted in the design of a differential temp-controlled pressure-compensated dist column, for the separation of benzene, toluene, and xylenes to meet stringent nitration grade specifications. B. A. F.

PRODUCTS

CHEMISTRY AND PHYSICS

318. Recent studies of metallic friction. F. P. Bowden. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1142–69.—*Cf.* Abs. **826**, 1955.

319. Nomogram for the calorific value of benzole vapour. G. E. Mapstone. *Industr. Chem. Mfr*, 1955, **31**, 358–9.—Chart designed on assumption that benzole is mixture of aromatics and paraffins. Given sp. gr. at 15·6° C and mean b.p. (50% point in STPTC dist), there can be obtained: paraffin content; mean mol. wt.; ft^3/lb of vapour; cal. val. vapour. Deviations caused by presence of naphthenes and of olefins are indicated. V. B.

320. Symposium on pulsatory and vibrational phenomena. Various. *Industr. Engng Chem.*, 1955, **47** (6), 1152–84.—The application of pulsation to liq–liq extraction (W. A. Chantry *et al*, pp. 1153–9) provides turbulence through the column and may increase extraction threefold. A detailed study of both packed and sieve-plate columns showed that efficient performance could be achieved at low feed rates by pulse action. Only a slight reduction in flooding rate was noticed. Sieve plates must have fine holes such that the column would not work without the pulsating action. Existing packed columns can be modified to act conventionally or as pulse columns. With some systems, emulsion formation may be a problem. A. C. Jealous and H. F. Johnson (pp. 1159–66) present data for the power requirements of a 50-ft pulse column 24 inches in dia and develop a theoretical equation for the power input as a function of the static head of the liq column, the acceleration forces on the liq system, and the friction losses. Other subjects included in the symposium cover the effect of sonic energy on fluidization, convective heat transfer, flame front stability, and chemical reaction. Instruments used in studying sonic phenomenon and sonic problems associated with their use are described. B. A. F.

321. Carboxylic acids synthesis by reaction of unsaturated compounds with carbon monoxide and water in the presence of solvents. R. Ercoli. *Chim. e Industr.*, 1955, **37** (13), 1029–32.—The author has investigated the possibility of synthesizing carboxylic acids from olefinic cpds, carbon monoxide, and water using dicobalt octacarbonyl as cat and acetone or dioxane as solvents. By the use of suitable solvents the reaction could be carried out at temp of 120°–165° C and under total pressures of 100–300 atm, obtaining conversions and yield of *ca* 80–90% in 2–3 hr. Good results have been achieved with all the olefins higher than ethylene tested up to now (propylene, 1-hexene, *cyclo*hexene, 2-ethyl-1-hexene) and in the carboxylation of crotonic and undecylenic acids. Under comparable conditions olefins react with CO and water at a higher rate than with CO and methanol. As in the related hydroformylation reaction, the rate of the carboxylation is strongly dependent of the structure of the olefinic cpd.

(Author's abstract.)

322. Diffusion coefficients in hydrocarbon systems. L. T. Carmichael *et al*. *Industr. Engng Chem.*, 1955, **47** (10), 2205–10.—Measurement of the Maxwell diffusion coeff for *n*-heptane in the gas phase of the methane–*n*-heptane system was made at pressure up to 60 p.s.i. and in the temp range 100°–220° F. Values of the interfacial resistance coeff were small. Data indicate that with fugacity or partial pressure as the driving force the Maxwell hypothesis is only a fair means of describing the transport of methane in the gas phase of lighter hydrocarbons. B. A. F.

323. Vapour–liquid equilibrium data for binary mixtures of paraffins and aromatics. H. S. Myers. *Industr. Engng Chem.*, 1955, **47** (10), 2215–19.—Data for 5 paraffin–aromatic systems show them to behave non-ideally. B. A. F.

324. Phase equilibria in hydrocarbon systems. Volumetric behaviour of *n*-heptane. W. B. Nichols *et al*. *Industr. Engng Chem.*, 1955, **47** (10), 2219–21.—Measurements of the effect of temp and pressure on the molal volume of *n*-heptane in the liq state were made at pressures up to 10,000 p.s.i. and at temp in the range 40°–460° F. B. A. F.

325. Ternary liquid–liquid equilibria of some hydrocarbons with sulphur dioxide. C. N. Satterfield *et al*. *Industr. Engng Chem.*, 1955, **47** (7), 1458–62.—The systems benzene with *n*-butane, *n*-hexane, *cyclo*hexane, *n*-heptane, and *n*-decane; toluene with *n*-heptane; xylene with *n*-nonane; and *sec*-butylbenzene with *n*-decane were all studied with sulphur dioxide as the third component at −20° F. The system sulphur dioxide–benzene–*n*-heptane was also studied over the range 0° to −35° F. Results on these model systems should

make possible the accurate determination of extractions of a variety of hydrocarbons. B. A. F.

326. Adjustment of vapour–liquid equilibrium data. D. B. Broughton and C. S. Brearley. *Industr. Engng Chem.*, 1955, **47** (4), 838–43.—The method of adjusting thermodynamically inconsistent data is based on the assumption that systematic errors are present in data from recirculating stills due to rectification or entrainment. The method has been tested on data for the systems methanol–water and methanol–ethanol–water. After independent adjustment the binary and ternary data were consistent. B. A. F.

327. An accurate simple formula for the activity coefficient of vapours. H. G. Elrod. *Industr. Engng Chem.*, 1955, **47** (10), 2199–200.—An easily-remembered approximation for relating activity coeff and compressibility factors of vapours at pressures less than critical. B. A. F.

328. Chemical feeding and proportioning equipment. R. W. Henke. *Industr. Engng Chem.*, 1955, **47** (4), 684–95.—The equipment described is limited to soln feeding, and types are classified according to feed requirements, delivery mechanism, etc. Tables of materials of construction and their chemical resistance are given. B. A. F.

329. The need for partial molal enthalpies. K. H. Hachmuth. *Proc. nat. Gas. Ass. Amer.*, *34th ann. Conv.*, 1955, 75–9.—Increasing use of sub-atm temp at rather high pressures has put a premium on accurate knowledge of enthalpies. Data and information on the enthalpies of cpds in mixtures under these conditions are by no means well developed. This discussion gives a brief review of the status of our information on partial enthalpies and describes some of the methods that have been used to estimate them. 1 table, 20 refs.
(Author's abstract.)

330. Equilibrium ratio charts for hydrocarbon systems, a new publication by NGAA. E. I. Organick. *Proc. nat. Gas. Ass. Amer.*, *34th ann. Conv.*, 1955, 66–70.—Quantitative knowledge of equilibrium vaporization ratios, or K-values, *i.e.* the engineering name for the volatility properties of hydrocarbons, is essential to the efficient design of fractionators, strippers, separators, and many other separation processes and equipment. The latest information on equilibrium ratios is, therefore, essential to engineers and chemists in the petroleum industry. These criteria are readily satisfied by the publication of over 100 charts with a short introductory text showing how to use them. 1 table, 2 figs. M. P. T.

331. Equilibrium ratios developed from an equation of state. C. L. DePriester. *Proc. nat. Gas. Ass. Amer.*, *34th ann. Conv.*, 1955, 73–5.—This paper is a short review of significant recent developments in calculation of vapour–liquid equilibrium ratios from the Benedict equation. A large volume of work is represented, and the resulting correlations are receiving increasing acceptance as practical engineering tools. Success of this approach suggests several promising directions for additional research. 1 table, 18 refs. (Author's abstract.)

332. Mutual solubility relation of alkyl phenols and water. L. von Erichsen and E. Dobbert. *BrennstChemie*, 1955, **35** (21–22), 338–44.—Apparatus and method for determining the solubility equilibrium between H_2O and C_6H_5OH are discussed. Physical data and measured results for 17 monovalent phenols are tabulated and formulæ given. From solubility curves and crit soln temp, the influence of the degree of alkylation and its position relative to the hydroxyl function on the solubility behaviour appears. Numerous charts and tables are given, and results and conclusions are discussed. 14 literature refs. R. T.

ANALYSIS AND TESTING

333. Importance of limit CFR engine operating conditions in knock detection. S. K. Banerjea, C. Meyer, and R. Vichnievsky. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1134–41.—Anti-knock rating can be measured by determining, using statistical assessment, mean amplitude of vibrations occurring on detonation and evaluated by electronic amplitude selector fed by signals from detonation-meter type detector. Results are given of tests on CFR engine showing effect of varying C.R., mixture strength, spark advance. Tolerances permissible by standard ASTM knock rating procedure can cause 5% variation in mean amplitude of detonation vibrations; use of latter enables anti-knock rating to be determined with same precision as by standard method. (*Cf.* Abs. **491**, 1954.) V. B.

GAS

334. Petroleum and natural gas. The Petroleum and Natural Gas Department, Canadian Bank of Commerce, Calgary. *Canad. Min. metall. Bull.*, 1955, **48** (522), 684–6.—A summary of developments in W. Canada, where ¼ of all development drilling is concentrated in the Pembina field, from 16 Aug. to 15 Sept. Approx 180 rigs are operating in Alberta, 62 in Saskatchewan, 12 in Manitoba, and 10 in British Columbia.

A 1200-mile pipeline for Alberta natural gas may be constructed from Winnipeg to Toronto. Canada consumed 502,000 b.d. of crude in 1954, an increase of 16% over 1953, and produced 55% of her total crude requirements, the remainder being imported from Venezuela, the U.S.A., Arabia, and Trinidad. 2 tables. M. P. T.

335. Gas reduction of ores. J. Rosier. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1115–25.—Blast furnace process considered from aspect of material and heat balances, also cost, so as to obtain comparisons any natural gas reduction process would have to face. Existent industrial gas (CO/H_2, H_2) reduction processes are briefly described, and published experimental work on use of petroleum and natural gas is reviewed. Main problems are slow reaction rates, adhesion of iron produced to vessel walls, ore selection. V. B.

336. Absorption and distillation at the Tioga plant. J. B. Taylor. *Proc. nat. Gas. Ass. Amer.*, *34th ann. Conv.*, 1955, 4–8.—Owing to the lack of a plentiful water supply and the extremes of local weather conditions, the natural gas is dehydrated before absorption, thus making it possible to operate the absorption plant free of freezing materials and water. Much of the plant is out of doors, and operating conditions can be observed, and controlled, even during inclement weather, from the control room.

90% of the high propane content of the gas is extracted, and 7000 m.c.f. of ethane and methane is discarded for plant fuel use. Absorption, rich oil rectification, and dist procedures are discussed. 5 figs, 1 table. M. P. T.

337. Composition of the Lacq gas. J. Buzon and J. Favre. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 387–90.—In the analysis of the gas, because of its nature mass spectrometry and low-temp fractionation were used, as well as i.r. absorption spectrometry. Details of the procedure are given. The volumetric composition was approx CH_4 60%, C_2H_6 2·5%, C_3H_8 0·5%, butanes to hexane 2%; H_2S 16%, CO_2 14%, N_2 5%; methyl, ethyl, and propyl mercaptans 0·01%, 0·005%, and $<0{\cdot}005\%$ respectively; COS 0·03%, He 0·002%.

The analyses are for the flowing gas and for gas extracted from a core. G. D. H.

338. Lacq gas should serve for carbon black production. V. Charrin. *Chim. et Industr.*, 1955, **74**, 782–3.—Lacq gas (CH_4 with 15–20% H_2S), proven reserves $1{\cdot}5 \times 10^{10}$ m³, in excess of present gas-fuel needs of SW. France; could, after S removal, supply total French (7000 tons/yr, now imported from the U.S.A.) requirements of C black at daily gas consumption (furnace process) of 10^6 m³. V. B.

339. Conversion of refinery gas into a gas interchangeable with ordinary town gas. L. Massimilla. *Riv. Combust.*, 1955, **9** (10), 759–88.—The author particularly turned his attention to the conversion of hydrocarbons, up to C_4 by steam, at varying temp on piles of silico-aluminous refractory material

or coke-beds. Preliminary investigations in conjunction with thermodynamic considerations enable the behaviour of these complex transformations to be foreseen, their accomplishment being notably influenced by kinetic factors which are in turn connected with the temp and the presence of the above-mentioned solids. Trials have been made on an industrial scale with a gas producer generating 60,000 m^3/day of integral gas. (Author's abstract.)

340. Kinetic interpretations of the heterogeneous catalysis and their applications to the high pressure reactions of gases. II. Methanol synthesis with copper-containing catalysts. C. Natta, G. Mazzanti, and J. Pasquon. *Chim. e Industr.*, 1955, **37** (13), 1015–25.—The authors have extended the kinetic researches on the methanol synthesis, started some years ago, to the copper-containing cat. These cat, which are generally considered too sensitive to poisons in front of the zinc–chromium cat, may be of practical interest if, as raw material for the synthesis of methanol, methane is used from natural gases, which, like the Italian ones, do not contain sulphur. Kinetic determinations have shown that the same kinetic equations, found by the authors for the Zn–Cr cat, may be used for the Zn–Cr–Cu stabilized cat. Because of the higher activity and lower activation heat, these cat may be used to carry out the synthesis at temp of 300°–330° C, at which the Zn–Cr cat show a very low activity. Copper-containing cat, because of their high sensitivity to superheating, may be used only for low pressure or low temp syntheses, and for high pressure synthesis with a low CO content. The authors discuss the significance of the activated absorption constants of the reagent gases, deduced from the kinetic equations. The authors point out that only part of the gases adsorbed takes part in the cat process. (Authors' abstract.)

ENGINE FUELS

341. The effect of auxiliary fuels on the smoke-limited power output of diesel engines. L. D. Derry, E. M. Dodds, E. B. Evans, and D. Royle. *Proc. Instn mech. Engrs, Lond.*, 1954, **168**, 280–6.—The tendency for diesel engines, particularly those used in road vehicles, to produce exhaust smoke is one of the principal factors which limits their power output. In order to comply with U.K. regulations, a smoke density of up to 0·15 (corresponding to 29% smoke) is generally considered a satisfactory max. In consequence, only some 65–70% of the available air can be burnt.

Results obtained with a 6-cyl 4-stroke automotive diesel engine indicate that by reducing the full-load quantity of diesel fuel injected and aspirating a volatile fuel, such as gasoline, into the intake air, power outputs of 20% or more above the max rated load can be obtained without producing more smoke than when the engine is operated at full load under normal conditions. Approx 80% of the available air can then be utilized.

Max smoke-limited powers were obtained when the auxiliary fuel had a high O.N. By limiting the power of diesel fuel alone to approx 80% of the normal max and aspirating gasoline into the intake, it is possible to obtain a power increase of approx 12% at all speeds between that of max torque and max power without increased smoking or the occurrence of knock.

Owing to improved economy, the fuel cost per b.h.p/hr, using gasoline aspiration, is not increased. Modifications required to the engine are slight and the fuels required to operate are readily obtainable. If the auxiliary fuel should run out no damage would be done to the engine. 10 figs, 8 tables, 4 refs. M. P. T.

342. Heptane oxidation in spark-ignition engines. F. Mauss. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1126–33.—CFR engine, CR 4/1, ignition cut every 5th cycle, quartz pressure head transmits electrostatic charge to one axis of C.R.O., oxidn and auto-ignition can thus be detected. Tests with C_7H_{16}, do. + 0·05% TEL, and 60/40 C_7H_{16}/*iso*C_8H_{18} at 900 rev/min and with C_7H_{16} at 600 rev/min. Results are plotted against mixture richness and inlet temp. Results influenced by residual gas from previous combustion cycle. TEL inhibits auto-ignition, but has little effect on oxidn, addition of *iso*-C_8H_{18} affects both phenomena. Lower rev/min increases auto-ignition and oxidn, especially at greater richness. Pb deposits in engine favour auto-ignition, although (separate tests) there is no evidence that clear O.N. are depressed if engine is previously used for fuel containing TEL. Experimental conditions for various oxidn and auto-ignition test procedures published since 1950 are tabulated. V. B.

343. Emulsified fuels in compression-ignition engines. I. Cornet and W. E. Nero. *Industr. Engng Chem.*, 1955, **47** (10), 2133–41.—The use of additives to improve the cetane No. of diesel fuels has been widely investigated. Many water soluble cpds which would theoretically make good additives are insoluble in diesel fuel. The possibility of using water as a carrier led to the study of the effect of emulsified water in diesel fuel on the performance of a 2-stroke cycle, 2 cyl engine. Below 7 wt % of water, the specific fuel consumption increased, but further addition of water up to 33·6 wt % caused no increase in the fuel consumption over that of plain diesel fuel. The exhaust temp increased up to 18 wt % of water and then decreased. The amount of smoke and carbon deposit was reduced by the use of water, and the injection timing affected the performance. B. A. F.

344. Mechanism of aromatic amine anti-knock action. J. E. Brown *et al.* *Industr. Engng Chem.*, 1955, **47** (10), 2141–6.—The anti-knock performance of 104 aromatic amines was determined in a single-cyl test engine. Several new anti-knock cpds were found, and the work led to a theory of the mechanism of the anti-knock action of aromatic amines. On the basis of this theory, a prediction is made as to the best possible amine anti-knock agent. B. A. F.

345. Calculating gasoline blend octane ratings. W. F. Schoen and A. V. Mrstik. *Industr. Engng Chem.*, 1955, **47** (9), 1740–2.—The octane rating of a gasoline blend is often higher than indicated by the arithmetic mean of the component octane ratings. An investigation was undertaken to determine the deviation from the arithmetic mean. The deviation is given as a function of the differences of the olefin content and the octane rating of the components. The method permits the accurate calculation of octane ratings of refinery stocks. B. A. F.

GAS OIL AND FUEL OIL

346. Tackling the residual fuel problem. Pt 3. Anon. *Oil Eng.*, Oct. 1955, **23** (268), 242.—Description of General Electric Co's experience with residual fuels in gas turbines. Their specification for fuel oil is given; sodium should not exceed 10 p.p.m., and if necessary the fuel should be washed and centrifuged to reduce the sodium content to this value. Magnesium sulphate is used for washing the fuel. Soluble magnesium salts are used as additives. A diagram of the treatment system for residual fuels is given. One literature ref is included. C. B.

BITUMEN, ASPHALT, AND TAR

347. Rheology of bitumen and related materials. O. Kirschmer. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (10), 336–9.—Discussion of ideal solids and liq precedes mathematical treatment of ideal solids and Newtonian liq, and recent rheological observations on petroleum bitumen (non-Newtonian liq) behaviour. R. T.

348. Bituminous materials, their processing and use mirrored in recent German patent literature. H. Hoffmann. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (10), 354–5.—Further full descriptions of recent patents with illustrations. R. T.

349. Calculation of water vapour migration. A. W. Rick. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (10), 344–7.—Pt II

extends the comprehensive article on wandering and damming of moisture in roofs and buildings, where use of bitumen is discussed. R. T.

350. Binders for carbon electrodes. T. Temme. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (10), 340–3.—Note on sp properties required in pitch or petroleum dist residues as C-electrode binders, with relevant tests and supporting diagrams. R. T.

351. Suitability of chip concrete for track surfaces. O. Rothfuchs. *Bitumen, Teere, Asphalte, Peche*, 1955, **6** (10), 350–2.—Compositions are given of 2 chip and one gravel concrete. Mech tests described show that coarse rock chip addn improves compression, bending, and abrasive strength of well-compressed concrete. R. T.

SPECIAL HYDROCARBON PRODUCTS

352. Properties of paraffin waxes. Composition by mass spectrometer analysis. W. R. Turner *et al.* *Industr. Engng Chem.*, 1955, **47** (6), 1219–26.—Composition of paraffin waxes was determined in a high temp mass spectrometer and the variations in composition were related to different physical properties as determined by standard physical tests. The distribution and relative amounts of the *n*-paraffins, *iso*-paraffins, and *cyclo*paraffins were shown to affect properties such as m.p., blocking temp, penetration, and tensile strength. In general, low m.p. "tails" in the mol. wt. distribution give higher penetration values and lower blocking temp; an increased "peakedness" in the mol. wt. distribution of the *n*-paraffins gives a higher blocking point and a more rapid rise in penetration with temp; a large *n*-paraffin content favours a lower penetration and higher blocking temp and a large percentage of high mol. wt. *iso*- and *cyclo*paraffins raises the tensile strength. B. A. F.

DERIVED CHEMICAL PRODUCTS

353. Petrochemicals in agriculture. E. D. Crittenden. *Proc. nat. Gas. Ass. Amer.*, 34*th ann. Conv.*, 1955, 58–65.—The paper develops the background story of petrochemicals in agriculture, and demonstrates the increasingly beneficial effects they will have in the future. The principal categories considered are plant foods, plant growth protectors and regulators, and animal protectants and growth promoters. 6 figs, 7 tables. M. P. T.

354. *p*-Xylene from petroleum. H. W. Haines *et al.* *Industr. Engng Chem.*, 1955, **47** (6), 1096–103.—*p*-Xylene is the starting material for polyethylene terephthalate, which is finding an increasing field of application. This staff-industry collaborative report outlines a process in which low temp fractional crystallization is used to separate *p*-xylene from mixtures of other, close b.p. aromatics produced by hydroforming naphtha and extracting a stock containing 16% *p*-xylene with sulphur dioxide. The process involves crystallization of *p*-xylene at −95° F followed by centrifuging to an 80% concn. This is then recrystallized at 0° F, giving a finished product of 95% purity. B. A. F.

355. Dihydroxynaphthalenes and some derivatives as gasoline anti-oxidants. R. B. Thompson and J. A. Chenicek. *Industr. Engng Chem.*, 1955, **47** (7), 1431–2.—A considerable number of dihydroxynaphthalenes were synthesized and tested in order to determine the structural features necessary for good anti-oxidant behaviour in gasoline. Data shows that the potency of the cpd is decreased by the introduction of an alkyl group into any nuclear carbon atom; that for 1-4-dihydroxy-naphthalene, alkylation of one hydroxy group imparts a slight potency; and that for dihydroxynaphthalenes having hydroxy groups on different rings the unsubstituted cpds show some inhibiting potency, and alkylation of one of the hydroxy groups decreases the potency. B. A. F.

CORROSION

356. A progress report on gasoline plant corrosion. W. M. Kyger and G. L. Shepherd. *Proc. nat. Gas. Ass. Amer.*, 34*th ann. Conv.*, 1955, 9–12.—Internal corrosion of steel pipe, pressure vessels, and other equipment in contact with sweet natural gas and hydrocarbons has been detected at 2 E. Texas and Panola plants. It is presumed that the corrosion is caused by oxygen and carbon dioxide in the incoming gas, combined with water to form corrosive acidic cpds.

Corrosion tests are discussed, details of inhibitor are given, points of corrosion are enumerated, and the procedure for the introduction of boiler blowdown water is described. pH checks were made daily and other corrosion problems are mentioned. 3 tables. M. P. T.

357. Experience with a corrosion control program for a unit dehydrating gas with diethylene glycol. W. Swerdloff and M. Duggan. *Proc. nat. Gas Ass. Amer.*, 34*th ann. Conv.*, 1955, 22–9.—Operating problems owing to corrosion in a gas dehydration unit employing diethylene glycol as the dessicant are described. Coupon results indicate the effects of the steps taken to decrease corrosion.

Conclusions reached are: (1) that progress has been made in reducing corrosion in the rich glycol soln, the lean glycol soln, and the dried gas line; (2) that while corrosion test coupons may give indications of the effectiveness of control programmes, inspections of the equipment are needed to determine how it has been affected by the treatment; and (3) continual attention must be given to the details of the programme to receive max benefits. 7 figs, 1 table. M. P. T.

358. Corrosion aspects of the vanadium problem of gas turbines. S. H. Frederick and T. F. Eden. *Proc. Instn mech. Engrs, Lond.*, 1954, **168**, 125–34.—The effect of V_2O_5 and mixtures of V_2O_5 and Na_2SO_4 on turbine fouling is discussed, and special reference is made to the burning of cheap residual fuels in marine gas turbines. During the combustion process, these fuels yield sulphur oxides and inorganic ash in addition to the normal products of combustion. Smaller quantities of sulphur oxides are also produced when dist fuels are burnt, but the production of a harmful inorganic ash in any quantity is abnormal because ash-forming constituents usually remain in the still bottoms during the fractionating process.

Blade fouling in a 500-h.p. gas turbine in 8 hr has been reported by earlier workers when experimenting with residual fuel oils, but no reference has been made to blade corrosion. Lab tests have shown that none of the commercially available alloys is immune from attack at temp above 650° C, but nickel-base heat-resisting alloys of the Nimonic type offer higher resistance to attack than the austenitic steels, and some degree of protection is afforded by electro-deposited coatings of chromium. On the other hand, copper-base alloys suffer considerable corrosion at temp as low as 500° C.

The corrosion rate of V_2O_5–Na_2SO_4 ashes indicates that corrosion can be considerably reduced by the addition of a mixture of oil as water soluble materials with the fuel, by suspension in the fuel, or by a separate injection into the combustion chamber with the object of reducing corrosion and deposition.

Although the authors treat the lab tests with some reserve, especially the rate of corrosion, experience has shown them to be almost indispensible guides to the more time-consuming rig and engine tests. 11 tables, 4 plates, 8 refs.

The paper is followed by communications and 2 figs. M. P. T.

359. Operation and performance of solution reclaimers for glycol–amine solutions. F. Paredes. *Proc. nat. Gas. Ass. Amer.*, 34*th ann. Conv.*, 1955, 17–21.—A description of dist units for reclaiming glycol–amine–water soln in desulphurization and dehydration plants is given. Operation and per-

formance of these units; also the practical methods of analysis for degradation products of glycol–amine soln are presented. 11 figs, 1 table. (Author's abstract.)

360. Protective coatings for cooling tower piping headers. R. L. Elkins and G. O. Hult. *Proc. nat. Gas. Ass. Amer.*, 34*th ann. Conv.*, 1955, 13–16.—Results of employing vinyl, epoxy ester, or modified phenolic resin paints to cooling tower piping headers indicates, 2 years after their application, that protective coatings, if applied properly and in sufficient film thickness, can control corrosion, and thereby reduce appreciably the expense of maintenance. 1 table, 5 figs. M. P. T.

ENGINES AND AUTOMOTIVE EQUIPMENT

361. An experimental investigation into the effect of fuel addition to intake air on the performance of a compression-ignition engine. W. T. Lyn. *Proc. Instn mech. Engrs, Lond.*, 1954, **168**, 265–79.—Much of the paper is devoted to a study of introducing a part of the fuel charge with the intake air. Investigations were carried out with various types of fuel used for the aspirated as well as the main charge. Combustion chamber design, C.R., and timing of both parts of the charge were also investigated, and it is concluded that a lean aspirated mixture does not lead to complete combustion.

Finally, the effect of some additives on the reactions of the aspirated fuel and the ignition of the main fuel were studied. 21 figs, 5 tables, 2 appendixes, including 13 refs. M. P. T.

SAFETY PRECAUTIONS

362. Fire protection for gas turbine compressor stations. E. E. Taylor and L. J. Fast. *Pipe Line News*, 1955, **27** (9), 29–34.—Modern pipeline compressor stations, often remotely situated and lacking good water supplies, need carefully planned fire protection. Where stations are manned by a single operator, a certain amount of automatic shut-down and fire fighting equipment is needed. Gas turbine operation entails having high pressure oil lines for bearing lubrication and exposed surface temp of 1450° F, both of which constitute considerable fire hazards. A description is given of the operation of an automatic water spray system, controlled by an automatic fire-detecting device. B. A. F.

MISCELLANEOUS

363. Consumption of petroleum derivatives 1946–54. R. Protic and S. Boskovic. *Nafta* (*Yugoslavia*), 1955, **6** (8), 261–7.—In the total production of energy in Yugoslavia liq fuels participated in 1947 with 4·9% and with 11·7% in 1953. The total consumption of petroleum derivatives was: 1946, 226,000 tons, index 100; 1947, 289,000 tons, index 128; 1948, 346,000 tons, index 153; 1949, 411,000 tons, index 182; 1950, 527,000 tons, index 232; 1951, 506,000 tons, index 223; 1952, 483,000 tons, index 214; 1953, 603,000 tons, index 266; 1954, 673,000 tons, index 297. A separate tabulation gives the consumption of the main derivatives in the past 10 years, and a comparison of the consumption structure *v.* the world consumption structure. A tabulation of the consumption as per application shows that transport takes 49%, industry 31%, agriculture 13%, broad consumption 7% of the total. Of especial interest is the consumption of liq fuels in the several industrial branches, and the percentage of consumption in the several republics. Based on the present rate of increase of consumption, the authors presume that in the next 10 years the consumption of petroleum derivatives will increase up to 1½ million tons in 1964. (Authors' abstract.)

364. Measuring, sampling, and testing crude oil and petroleum products. Various. *Proc. Amer. Petrol. Inst.*, 1954, **34** (6), 169–201.—The background and organization of the symposium is stated. There are four papers devoted entirely to U.S. practice, as follows:

(1) 95 years of bulk oil measurement. The paper develops the various trends in crude oil measurements and tests, and includes notes on early markets, the oil barrel, transportation, improved facilities, origin of gauging equipment, refining, natural gas, natural gas liq, marketing, and the part played by associations, industry groups, and the API in improving means and methods for the measurement, sampling, and testing of crude oil. 1 fig, 22 refs.

(2) Present methods of bulk oil measurement and desired improvements. The importance of accurate oil measurement is stressed, fundamental definitions of volume, density, sampling, and testing are given, and the principles and methods of measurements are discussed. The quantity of a liq may be measured either when it is still or when it is moving. The former is the older method of the 2, and is largely being superseded by the latter. Notes on the measurement of quantity refer specifically to volume measurement, manual gauging, automatic gauges, position-displacement meters, Venturi meters, meter calibration, and weight measurement.

Measurement of temp, measurement of quality as incidental to quantity determination, qualification of inspectors, and desirable improvements of uniform measurements and testing codes and practices are also dealt with. 7 figs.

(3) A glance into bulk oil measurement of the future. The automation of the petroleum industry is making rapid strides. As the demand for petroleum products increases, the economic incentive for more efficient means of measuring, sampling, and testing crude oil and its products also increases. The paper summarizes some of the applications of automatic measuring, sampling, and testing equipment to current petroleum-industry operations and looks ahead to the more extensive use of automatic equipment as a natural evolutionary process in the industry. The objective is the immediate preparation of those financial statements and operating control statistics which management has found to be essential for prompt and intelligent business decisions. 10 figs.

(4) Management looks at bulk oil measurement. The importance of bulk oil measurement in the light of past experience and present practice is discussed. The complexity of basic problems is outlined, *e.g.* standardization in measuring, sampling, and testing—essential to the evaluation of crude oil and its products—must embrace solid, liq, and gaseous phases, each varying through wide ranges of composition and properties as related to handling and use. The paper warns that although a certain feeling of satisfaction with accomplishment to date is justified, that is no justification for adopting a policy of complacency. The authors of the 4 task groups who prepared the 4 papers are listed. M. P. T.

365. Plastics as materials of construction. Various. *Industr. Engng Chem.*, 1955, **47** (7), 1292–367.—The suitability of plastics for various industrial applications is considered under the 3 main headings of engineering aspects and evaluation; equipment applications; and industrial applications. Experience in oil production applications (B. W. Bradley, pp.

1353–8) indicates that there is inadequate test data upon which to base the design of pipelines, tubing, and storage tanks. There is a need for reliable plastic equipment of these types for high-pressure work with corrosive oil–water–gas syatems and for high-strength plastics for flood water service and salt field water disposal. B. A. F.

366. Eighth annual review of unit processes in chemical engineering. Various. *Industr. Engng Chem.*, 1955, **47** (9), 1825–943. Reviews of particular petroleum interest are:

Alkylation: There is still an increase in capacity for the production of alkylate to upgrade gasoline. A patent has been granted for the upgrading of saturated gasolines by a combination of cracking, reforming, and alkylation processes. A process for the removal of fluorine cpds from material subjected to hydrogen fluoride alkylation or isomerization has been described.

Decomposition of hydrocarbons: A great deal of fundamental research into thermal and cat cracking has been published during the year. Developments in the application of precious metal-reforming cat have continued. 2 new processes have been announced for the production of high octane gasoline.

Hydrogenation and hydrolysis: Aspects reviewed include new work on Fischer–Tropsch synthesis, desulphurization of petroleum and coal dist, and hydrogenation of coal and petroleum products.

Isomerization: The review covers the work published in the last 3 years. Little work has been done with aluminium chloride cat. Cat studied include a 5% nickel on silica–alumina base and platinum and chlorine in a fixed bed of alumina for reforming C_5–C_8 paraffins. Molybdenum oxide has been used for the isomerization of pentane. Studies of hydrotreating processes for olefinic gasoline using a tungsten–nickel sulphide cat have shown the mechanism involved. There has also been some work on isomerization in cat cracking reactions.

Pyrolysis of coal and shale: Work has been done on the mechanism, kinetics, and thermochemistry of the pyrolysis of oil shale. Process, equipment, and products are reviewed.

Other reviews: The annual review also contains sections on esterification; amination by reduction; fermentation; halogenation; nitration; oxidn; polymerization; sulphonation and sulphation; and Friedel–Crafts reactions.

B. A. F.

367. Ninth annual review of materials of construction. Various. *Industr. Engng Chem.*, 1955, **47** (9), 1945–2064. Recent developments in the whole range of constructional materials, metals and alloys, ceramics, plastics, paints, rubbers, etc., are reviewed, and special sections give physical and chemical data on zirconium and titanium. B. A. F.

368. New law for California's offshore oil development. T. C. Moroney. *J. Petrol. Tech.*, 1955, **7** (10), 10–15.—The Cunningham–Shell Tidelands Act of 1955 removed that provision which had hitherto restricted the State's authority to issuing leases on submerged areas only where the lands were believed to be capable of oil drainage by wells on adjacent lands. The restriction of drilling only from existing piers, filled lands, or upland drilling sites was removed. The requirement of either cash bonus or royalty bidding was abolished. The terms for assignment quit-claiming and exchange of leases were modified. Permits for geological and geophysical surveys can now be issued by the commission, and its right to specify drilling terms is limited.

The new law has opened up 135 miles of coast for offshore exploration, and the choice of drilling site or type of site is greatly widened. One lease shall not exceed 5760 acres, or be less than 1920 acres unless on a known structure on which the area available is less than this. The highest cash bonus offered shall receive the award of the lease. The primary term for a lease is 20 years, and for production an indefinite term. On unproven lands the drilling term shall not exceed 5 years. Joint holding of leases is permitted. There is strong resistance to any obligation to have to disclose exploration information to the commission.

Various other aspects of the new law are discussed.

G. D. H.

369. Development and principles of French mining law concerning hydrocarbons. P. Desprairies. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1170–84.—Specific legislation concerning petroleum was initiated in France in 1922, laying down exclusive prospecting licences (granted by State) and concession right to successful prospector. Numerous subsequent changes have been made and the scope and background of these, including modifications of May 1955, are discussed and outlined; new legislation has paid particular attention to taxation and financial incentives. Modifications include: area of prospecting licence reduced at each renewal (15 years max, subject to adequate expenditure); transfer of geological information on expiry of prospecting licence; concession duration reduced from 99 to 50 years; tax concession for profits used for further prospecting; state subsidy on production (£6/ton for 1955) limited to max of 12% of income of previous year; financial concessions (guaranteed interest, etc.) to shareholders in prospecting companies. Appendixes give summarized texts of main legislation. V. B.

BOOK REVIEWS

The Petroleum Refinery Engineer's Handbook. J. F. Strachan. London: E. and F. N. Spon, 1955. Pp. xv + 168. 50*s*.

This is a revised and enlarged edition of a well-known book written by Mr Strachan, who was formerly Chief Plant Inspector at Abadan. The purpose of the book is to guide Plant Inspection Departments in all aspects of their work.

In the first chapter the author deals with organization, personnel, inspection methods and equipment, and methods of recording inspection data.

The second chapter deals with procedures used in the inspection of various types of refining plants. It can be of great assistance to the engineer new to the oil industry, and can give new "angles" to established inspection organizations.

Chapter III, which deals with the corrosion and protection of oil equipment, is of great interest. The perpetual struggle against corrosion is the most difficult and yet most interesting job of the refinery inspection engineer, and he is always keen to know of the problems encountered by others.

Chapter IV is a useful guide to strength calculations and the retiring thicknesses of equipment.

This well written and well presented book fulfils the needs of many Plant Inspection Departments. It presents, under one cover, valuable information on all aspects of the work of Plant Inspection Departments, and should be of particular use in the training of young inspection engineers.

J. R. B.

Chemical Reactions in Flow Systems. S. S. Penner. London: Butterworths Scientific Publications, 1955. Pp. 86. 21*s*.

This is the seventh of the Agardographs, the reports published for Aeronautical Research and Development, North Atlantic Treaty Organization. Although described as an introduction to the study of chemical reactions in moving ideal gas mixtures, the book does in fact present an advanced treatment of the problem of chemical reaction during flow and of heterogeneous chemical reactions. The book is divided into four parts. Chapter I deals with classical

chemical kinetics and the limitations of the steady state approximation for chain reactions; Chapter II with the conservation laws for reacting fluids and the determination of transport coefficients. Chapter III is devoted to the analysis of the problem of chemical reactions during adiabatic flow through a de Laval nozzle, and Chapter IV to heterogeneous chemical reactions, including reactions at a solid surface and the burning of single droplets of fuel in oxidizing atmospheres.

Much of the subject matter has been treated separately in publications on chemical physics (such as Hirschfelder's recent text on Molecular Theory of Gases and Liquids), combustion, fluid mechanics, and applied physics, but is brought together in a single monograph for the first time. The treatment throughout is uniform, and despite the highly mathematical nature, the subject is presented in a readable form. To research workers in the fields of reaction kinetics, hydrocarbon combustion, and the particular field of dynamics of reacting fluids the book will be of great value and much appreciated.

Messrs. Butterworths are to be complimented on producing the monograph in such an excellent manner at a price which will not preclude the interested non-specialist from adding the volume to his personal library. F. M.

ADDITIONS TO THE LIBRARY

British Standards :

B.S. 796 : 1955. Hose of Natural Rubber with Cotton or Rayon Braided Reinforcement. Pp. 38. 6*s*. net, post free.

B.S. 924 : 1955. Hose of Natural Rubber with Cotton or Rayon Woven Reinforcement. Pp. 43. 7*s*. 6*d*. net, post free.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

370. Development of fundamental ideas and techniques in petroleum geology. J. Flandrin. *Rev. Inst. franç. Pétrole*, 1955, **10** (9), 1039–52.—In the early days of the oil industry much of the drilling was in the neighbourhood of seepages, but later another aspect of seepages was recognized, namely that they were a guide to oil-forming conditions, but need not now always be closely linked with substantial accumulations underground. Furthermore, there was a tendency for operations to spread from the more strongly folded regions to areas with little or no folding and fracturing, or seepages. The importance of source, reservoir, and cover rocks, and of traps rather than structures was recognized. However, strong belief in the sand–shale series as a source series tended to localize exploration on the belts of folding and away from the epicontinental areas where there was less sedimentation and where limestones were more important. It is now recognized that some limestones can be source rocks and limestones can have considerable oil reserves. In addition some non-marine deposits have given rise to oil, and have yielded production and may have interesting future possibilities.

Views on migration have also influenced the selection of areas and horizons for investigation. *Ca* 1920 the anticlinal law dominated discovery thought, having gained ground from 1890. Some structures had only gentle dips and small closure. The details of a closely mapped surface structure could give an unwarranted appearance of certainty which did not apply at depth when the folding was strong, while form was given far more weight than lithology, stratigraphy, and palæogeography. Gradually it was realized that oil could accumulate in a variety of positions other than on anticlinal crests. The wildcatter played an important part in finding stratigraphic traps. The significance of the date of forma-

tion of a trap came to the fore, and so the structural evolution of an area assumed importance. Attention has also been directed to hydrodynamic factors, and to position in a basin. Drilling for stratigraphic information has been introduced, and this may call for the early drilling of a well deep in a basin.

The introduction of geophysics and rotary drilling offered opportunities for exploration in new areas or at greater depths. Seismic work, as well as other geophysical techniques, has its limitations. Core drilling can help considerably, while sedimentology contributes much in sub-surface geology, and electric logging has proved a boon in many directions. G. D. H.

371. " Statisticulating " for oil. F. J. Gardner. *Oil Gas J.*, 10.10.55, **54** (23), 319.—The results are reported of a statistical analysis of the distribution, structure, and reservoir rocks of 236 oil fields with 100 million brl or more recovery. *Ca* 70% of these fields occur on the stable side (hinge and shelf) of basins and 80% of the total amount of oil discovered is trapped in 156 anticlines. There are 185 fields with 59% of the oil in sand reservoirs, 96 fields with 40·2% in carbonate rocks, and 19 fields with 0·8% in other fractured rocks. 55 fields, containing 52·7% of all the oil discovered, produce from Cretaceous and other Mesozoic rocks, 92 fields and 28·7% produce from Mio-Oligocene, and Palæozoics and other Tertiary formations comprise the remainder. C. A. F.

372. Chloride content as an indicator for correlation of strata in Miocene. J. J. Glogoczowski. *Bull. Polish Inst. Petrol.*, 1954, **4**, 7–8 (suppl. to *Nafta* (*Krakow*) 1954, **10**).—Core examination of 5 wells, including 2 600 m apart and 3 approx 700 m apart in another area, showed that variation in Cl^- can be used for correlation of strata. M. S.

373. Photogeology and its application. J. Flandrin and R. Brasseur. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 283–94.—The history and techniques of photogeology are briefly described, reference being made to the first regional photogeological survey, carried out by Shell in New Guinea. The advantages and limitations of the technique are noted. In the New Guinea work an area of 106,000 km² was studied in 20 months, *ca* 5 geologists being engaged on the interpretation. The cost was 5000–6000 fr/km². It was estimated that there was 60% saving as compared with other methods. For some work in the Sahara the cost was 1900 fr/km², 1000 fr being for associated surface work, and 900 fr directly for photogeology (600 fr for the photography and 300 fr for the interpretations and compilation).

Photogeology can be employed in mining geology as well as in oil geology, but for satisfactory results well-trained interpreters must be used. G. D. H.

374. Texas hits big pay. Anon. *Oil Gas J.*, 3.10.55, **54** (22), 87.—1 Oil Development Co, a wildcat in NE. Gaines County, W. Texas, flowed 1521 b.d. of 32° oil from Mississippian pay at *ca* 13,000 ft. No gas was present on test. Granite was topped at 14,319 ft, and some shows were found in the Devonian. Another well, 1 Jones, in SW. Gaines County, found oil in Devonian at *ca* 12,700 ft : 165 brl of 45° mud-cut oil were recovered. C. A. F.

375. New pay spreads in Spraberry. R. J. Enright. *Oil Gas J.*, 24.10.55, **54** (25), 56.—Oil has been discovered in the Clear Fork in the Spraberry area of W. Texas and *ca* 40 wells have been completed. The pay is above the Spraberry sand, to which it is conformable, and its depth ranges from *ca* 5900 to 7100 ft. It is strongly fractured similar to the Spraberry, and porosity and permeability in the non-fractured zones are low. It differs from the arenaceous Spraberry in being a shaly dolomite.

Average well potential in the Clear Fork is *ca* 200 b.d., with a variable estimate of ultimate recoveries. Wells are acidized before completion, and *ca* 60% of them are plugged back from the depleted Spraberry pay. C. A. F.

376. What are Tennessee's oil possibilities? C. W. Wilson. *Oil Gas J.*, 3.10.55, **54** (22), 187.—Most wells drilled in Tennessee have been sited without regard to geological conditions, and although adequate structures and potential reservoir rocks are present, they have not yet been found in association.

The oil potentialities of the Eocene and Cretaceous and the Palæozoic are evaluated. Cretaceous and Eocene beds form a wedge thickening towards the NW. corner of the state; closed structures are unlikely but there may be stratigraphic traps up-dip to the east. Palæozoic rocks include source and reservoir rocks and closed structures and faulting may be expected on the SE. end of the Ozark dome; stratigraphical traps should also occur along the Palæozoic–Cretaceous unconformity.

Pay zones and source beds in each of the main structural provinces of Tennessee are noted. C. A. F.

377. Golden Gate opens on a new oil pay. F. J. Gardner. *Oil Gas J.*, 7.11.55, **54** (27), 163.—A well near San Francisco, 1 Asta in the Santa Cruz Mountains in the Boulder Creek area, has discovered oil in Butano–Oligocene sand at *ca* 2000 ft; production averages 70 b.d. of 41° oil. The discovery is at the SE. end of a Pliocene embayment extending NW. to the area of Halfmoon Bay. Old fields in the area were found on folds and faults trending NW.–SE. from Halfmoon Bay to La Honda, and discovery wells were drilled in areas of seeps.

The Boulder Creek discovery is expected to revive interest in these old areas, but complex subsurface folding and faulting make exploration difficult. C. A. F.

378. Wildcat promising. Anon. *Oil Gas J.*, 31.10.55, **54** (26), 61.—1 Costa, in the Santa Cruz Mountains, California, on test flowed 150–200 b.d. of 41·5° oil from 2 zones between 2000 and 3000 ft. The wildcat may be the most significant discovery in California in 1955 and is situated over 70 miles from the nearest field. C. A. F.

379. Operational problems in oil exploration in the Northwest Territories. R. A. Brown and M. E. Wopnford. *Canad. Min. metall. Bull.*, 1955, **48** (524), 783–9.—In an area extending over some 225,000 sq. miles N. of the 60th parallel in Canada, it will be readily appreciated that the main special problems of exploration for petroleum are derived from transportation, climate, terrain, and communications. Each of these subjects is therefore dealt with at length, and due emphasis is placed on the importance of planning and making arrangements well in advance of the " season " when operations are economically possible.

Supplies purchased in or delivered to the NW. Territories are more costly than elsewhere. Costs for a surface mapping party of 2 geologists using both fixed wing and helicopter aircraft support and other services and equipment as discussed in the article may be expected to be about 3 times those for a similar party operating in the Foothills region of Alberta with a pack-horse outfit. On a cost-per-sq-mile-surveyed basis, however, the costs in the 2 regions will be about the same, for the party using aircraft can cover about 3 times as much ground in the same time.

Airborne magnetometer surveys have been carried out in the Territories, and gravity and magnetic surveys based on readings taken on the ground have been considered but have not been undertaken. The geophysical work which has been done is mostly seismic, and some useful information is given on this subject.

It is concluded that there is no condition in the NW. Territories which renders exploration for oil impossible nor even extraordinarily costly, provided adequate planning is carried out sufficiently far in advance of operations. 1 fig. M. P. T.

380. Stratigraphy and tectonics of the sedimentary deposits of Martinique. L. Barrabé. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 295–308.—A provisional geological map of S. and E. Martinique is given. The formations include volcanic tuffs and intercalcated limestones of Oligocene and younger age.

In particular, the Vauclin tuffs (marine Aquitanian) are described in detail. 2 secondary anticlines have been indicated in the large synclinal area of Petite Grenade. It is considered that the abundance of organisms in certain horizons of the Vauclin tuffs makes such rocks possible oil source rocks. Other features are not incompatible with the formation and accumulation of oil, but no important oil indications have been noted. In 1927 traces of oil were described in the Sigy water boring, and heavy oil was noted in the bay of Galion and asphalt coatings on pebbles on the E. coast. It appears desirable that if further oil search were to be seriously considered an attempt should first be made to check the Sigy indications by a shallow boring. G. D. H.

381. Reconnaissance studies for petroleum in the Senegal sedimentary basin. P. Maugis. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 269–82.—Since 1952 reconnaissance work in search of oil has been undertaken in the Senegal river basin. This has included geological and geophysical investigations and some drilling, in addition to a study of the findings of various wells drilled for water. Outcrops of the older beds are relatively rare. Some Palæozoic beds occur, and considerable thicknesses of Mesozoic and Tertiary have been found in some areas. More than 13,000 ft of sediments occur in the central part. The geophysical work includes gravimetry, and refraction and reflection work. The top of the Cretaceous dips southwards broadly, but complications are known, for example, nr Dakar. Dips are generally gentle, but there are disturbances due to igneous intrusions. Various evidences of petroleum have been found: gas, bitumen, sulphurous water. Oil saturation has been noted in some sandstones. In the Tienaba well water emulsified with combustible gas has been met at depths of 2550 and 2700 m.

The data are as yet fragmentary, but are viewed favourably from the point of view of oil search. G. D. H.

382. The Upper Jurassic in the wells of the Regio Autonome des Pétroles and of the Société des Pétroles de la Garonne. P. Michel and V. Perebaskine. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 309–15.—1023 m of Upper and Middle Jurassic was found in well Muret No 2, 30 km SW. of Toulouse, under 830 m of mollase and alluvium. This comprised limestones and dolomite mainly, with some clays and limestone breccias. The succession is described in some detail, and there are shorter descriptions of the Jurassic in wells at Bordères, Mondilhan, Puymaurin, and Saint-Médard, where the existing thicknesses of Upper Jurassic (incomplete) are 406 m, 656 m, 402 m, and 131 m respectively; the corresponding thicknesses of Middle Jurassic are 287 m, 374 m, 282 m, and 260 m. Maps show the facies and thicknesses. It appears that in Upper Jurassic times a trough running NE.–SW. was formed N. of Saint-Marcet. Subsidence seems to have been slow and largely offset by sedimentation. The trough may be linked with the Villefranche-de-Rouergue fault. The data are incomplete and come mainly from anticlinal areas.

G. D. H.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

383. Geophysics and the search for oil. L. Migaux. *Rev. Inst. franç. Pétrole*, 1956, **10** (10), 1191–204.—Geological data can be very local and very precise, but access to material directly is restricted. Much that is vital is hidden, and although wells can be drilled to overcome this it greatly increases the costs. Moreover, on many occasions even complete surface data would not be adequate for a satisfactory construction of the subsurface structure. Geophysics can provide data on what is inaccessible, and makes use of the density, elasticity, magnetic, or electrical properties of the rocks. A good gravity meter can measure to 2×10^{-8} of g. To make good use of this various corrections are needed in practice: altitudes must be measured to a few decimetres. Indeed, the corrections are less precise than the instrumental values, and final precision is rarely better than 10^{-7} of g. Having determined the Bouguer anomalies they are not capable of uniquely defining the structure, although the choice of acceptable values for some factors eases the situation. A preliminary regional gravimetric survey can help, and in parts detailed work may be warranted. At the same time there may be a magnetic survey. Magnetic anomalies are dominated by basement effects. Gravimetric reconnaissance may cost 500,000 fr/km², and if magnetic work is done at the same time the added cost may be 200,000 fr/km². These techniques may direct attention to areas requiring further study by other means.

Electrical methods use natural or artificial currents. The effective depth of investigation can be varied. Electrical surveys may be twice as costly as gravimetric surveys, but this is largely balanced by the fuller information obtained. In seismic work reflection surveys have been dominant since 1930, although there has been more extensive interest in refraction work in recent years. In reflection surveys the cost may be 250,000–1,000,000 fr/km of profile, and in the search for oil 90% of the expenditure on geophysics may be on this technique. Costs for refraction are similar. The principles of all the techniques are given. G. D. H.

384. Test of geochemical prospecting by analysis of adsorbed gas on the Gouaro anticline. M. Louis and R. Pomeyrol. *Rev. Inst. franç. Pétrole*, 1955, **10** (9), 1053–6.—The Gouaro anticline in New Caledonia is 30 km long, with Upper Eocene exposed in the axis. The geochemical work was executed before drilling. 200 samples were taken at an average depth of 1 m, followed a year later by 18 samples in a crestal area which showed interesting anomalies. All the samples were from the Upper Eocene. They were sent to the I.F.P. The gas was desorbed under vacuum with attack by phosphoric acid. Homologues of CH_4 were condensed by liq air, and CH_4 was measured by combustion. 0·1 ml of CH_4 and 0·1 ml of the homologues could be detected in 1 kg of rock, the tests requiring a few tens of grams of rock. The hydrocarbons higher than CH_4 are significant; their concn was generally low, but some anomalies gave 8 ml/kg. Some high values occurred broadly in the crestal region, but the samples were not all ideally placed for defining this, only *ca* ½ of the structure being covered.

Well Gouaro 2 had traces of oil and gas at *ca* 200 m, and a sample from 87 m had 15·3 ml CH_4 and 8·5 ml of the higher members. Gouaro 1 had a core at 432 m with 18·7 ml CH_4 and 4·2 ml higher members, and 56·3 ml CH_4 and 7 ml higher members at 598 m. G. D. H.

DRILLING

385. New tool drills with steel balls. J. O. Scott. *Oil Gas J.*, 3.10.55, **54** (22), 84.—A new drilling tool developed in the U.S.A. is described. The device consists of a jet-type double nozzle which is attached to the tip of the drill pipe. Instead of the conventional bit, steel balls are jetted at the bottom of the hole by the normal mud stream. The balls erode the beds by pulverizing the rock, and they are returned partly up-hole in the mud stream with the cuttings; they are then siphoned off and returned down-hole with the mud.

The drill string is rotated very slowly during drilling, and in field tests a 9-inch hole was drilled using 1¼-inch hardened steel balls. Tests in rocks ranging from soft limestone to hard quartzite showed rates of penetration somewhat less than with conventional equipment.

Photographs of the equipment and a diagram are included. C. A. F.

386. Strength of oilfield tubular goods. A. Madrelle. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 395–413.—Many formulæ have been given in connexion with the strength of oilfield tubular goods, and it is necessary to choose wisely in using them, to consider the assumptions made in deriving them, and to apply suitable factors of safety. Various conditions are

considered in detail: resistance to internal pressure; resistance to external pressure; resistance to combinations of stresses—internal pressure, external pressure, longitudinal tension, or compression; strength of tool joints. Comparisons are made of the different formulæ. G. D. H.

387. Diesel engines in petroleum prospecting and production. P. Josse. *Bull. Ass. franç. Tech. Pétrole*, 1955, 553–67.—Discussion of factors involved in engine selection, the latter is facilitated by chart plotting h.p. and torque at various speeds for both continuous and intermittent rating; 20–25% excess power is desirable, but stress is laid on fuel wastage and excessive wear occurring when engines idle or operate at low proportion of normal power. Max safe piston speed should be 10–12 m/s, reducing to 9 m/s for drilling engines with long continuous working; max ratio stroke/bore is 1·3. Fuel consumption curves require careful interpretation, most useful form is kg/h.p.hr as a function of power at various speeds. V. B.

388. Some problems of deep drilling. W. M. Booth. *Canad. Min. metall. Bull.*, 1955, **48** (524), 764–8.—The article is confined to deep drilling in the range 15,000–20,000 ft at an average cost, according to one writer, of $580,000/well. Hitherto, the deepest well drilled in Canada was 14,443 ft in the Jumping Pound field, and the author seeks to explain the economic significance of drilling beyond this depth.

Emphasis is placed on the correct design of the hole and the casing-size programme, the latter being influenced by the drilling conditions to be encountered. Examples are given of casing-size programmes for 15,000- and 20,000-ft wells.

Notes are given on drill pipe and tubing, and the hoisting loads resulting from the use of tubular strings. It is stated that mud pumps are the largest power consumer on modern drilling rigs and that the advent of jet bits has changed the emphasis of h.p. from the hoist to the pump. As a result, the pumping and rotating requirements are the basis for designing total installed h.p. on most rigs.

Improvement in drilling tools, muds, and advancement of industry "know-how" have contributed much to improved drilling rate, which has been doubled during the past 10–15 years.

The complicated problem of obtaining trouble-free cementation of casing at 15,000–20,000 ft is also considered; on the other hand, the problem of packers for testing tools which will support the tremendous hydrostatic head still remains.

In conclusion, the author states that progress is being made in equipment and technique to drill wells economically, and it is reasonable to believe that wells will be drilled deeper than 15,000 ft within the next few years. 6 figs, 7 refs.

M. P. T.

389. Well completion and stimulation practices in Manitoba. H. Weiner. *Canad. Min. metall. Bull.*, 1955, **48** (523), 741–5.—The introduction of the fluid fracturing technique has caused a considerable increase in development drilling in Manitoba since 1953. The technique employs Daly crude as the carrying agent and sand as the propping agent, instead of kerosine with oil-soluble soap, which constituted the carrying agent in the hydrafrac technique, used formerly.

The plug and cement are drilled out after 48 hr W.O.C., and the open hole is circulated for 2 hr with water to clean out filter cake. Tubing (2 or 2½ inches) is run in and the hole displaced with oil. Packer or squeezer tools are not essential, except in cases when high breakdown pressures are anticipated, when the additional use of packers, squeeze tools, hydrochloric acid, or open hole perforating is recommended to safeguard the casing and the primary cement job. The breakdown of the formation is usually established with one high-pressure pump; and the sand-oil-mixture is displaced with 2 high-pressure pumps and flushed with 10–30 brl of crude oil.

After the well has been treated, the total oil which has been used is recovered and the well put on a 5–8 hr production test. If the results are satisfactory the well is then put on production.

Trends in production of various fields are described. 5 figs.

M. P. T.

390. Survey of methods of rotary drilling in Polish petroleum industry. Z. Turkowski. *Nafta* (*Krakow*), 1954, **10**, 177–82.—The progress of rotary drilling in Poland is smaller than in other countries. 3 different formations were drilled with rotary bits of 3 sizes. It was observed that as a rule the pressure applied was far from optimal. It should have been related to hardness of rock. Otherwise the relationship between depth/hr and number of revolutions, velocity of mud, and size of drill has been established. Information gained was passed on to the Central Administrative Office.

M. S.

391. Curvature of drill holes. S. Plewa. *Nafta* (*Krakow*), 1954, **10**, 189–90.—Reasons for such unwanted deviations and methods of their prevention. M. S.

392. Engine and drilling equipment units factory. J. Werynski. *Nafta* (*Krakow*), 1954, **10**, 160–3.—This base for Polish construction and production of equipment is making progress, but only half as well as planned in the 6-year plan.

M. S.

PRODUCTION

393. Anomalies on pressure bomb charts and their causes. M. Pierot. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 365–76.—The form of a typical pressure bomb chart is described, and its indications are linked with the various stages in the operation of drill-stem testing. The significance and in some cases the means of checking the various pressures are discussed. Anomalies in the records may be due to malfunctioning of the tester or recorder, or to faulty procedure. Examples of the various anomalies are given and discussed. G. D. H.

394. Study of acidization in a vesicular limestone. J. Nougaro and C. Labbe. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 354–64.—It is still not proved that fracture treatment gives increased total oil recovery, and it is possible that, for compact low-permeability beds, although the initial flow is increased the total recovery is reduced. Acidization may increase flow only a little, but may improve permeability more generally, and so some aspects of this process have been studied in detail.

The fine, pure limestone used had some inter-granular permeability, but mainly channel porosity. Cyl specimens mounted in rubber stoppers had acid and water forced through them at constant pressure. The end-faces were protected by plastic with 1-mm holes. The cross-section was 4·08 cm² and the length 0·75–4·5 cm. A known volume of acid was passed through the core, collected (with acid well washed out of the core), and neutralized to find the amount of limestone dissolved. The permeability of the core was measured with water. Theory required that $\sqrt{K} - \sqrt{K_0} = \lambda \frac{N}{V}$, where K is permeability after using N mol of acid, K_0 is the initial permeability, V the volume of the sample, and λ a coeff dependent on the rock. It was concluded that for a given consumption of acid it is desirable to push the acid as far as possible into the formation, and hence dilute soln are preferable.

G. D. H.

395. Measurement of gas and oil relative permeabilities. P. Albert and P. Chaumet. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 349–53.—A gas–oil soln above the bubble point behaves as a single liq, and the flow in a porous medium obeys Darcy's law. When the pressure falls below the bubble point gas is released, and when a sufficient concn (critical saturation) of

free gas exists the gas permeability is no longer zero. Gas liberation expels the liq phase, and measurements of the liq and gaseous flows and of the differences between the actual and bubble-point pressures permit the relative permeabilities to be calculated. This technique permits an accurate measurement of the critical saturation, for this exists when the first gas bubble issues with the oil. However, the flows to be measured are small, while fluid saturations are determined by material balance. Consequently the dynamic displacement method has been used. The sample tested was mounted in corite between 2 end-pieces of the same rock to remove end-effects. Manometers were fitted, gas was supplied from a cyl, and oil was supplied by a pump, while the separator and flow-meter are described. Saturations were determined by weighing. The sample was first saturated with salt water. This was displaced to the irreducible minimum by oil. Having attained the critical gas saturation, the oil rate was kept constant while the gas pressure was raised in stages, relative permeabilities being obtained at each stage.

The results of measurements on a piece of Vosges sandstone are given. G. D. H.

396. Device for determining the concentration of formation treating acids. J. L. Huitt. *J. Petrol. Tech.*, 1955, **7** (11), 57–8.—Measurements of acid concn by a hydrometer may be unreliable, and titration may not be suitable for well-site work. The device described has a reaction cell with a pressure gauge, temperature indicator, release valve, and sample holder, being ruggedly made of plastic and metal. The sample holder allowed $CaCO_3$ or a rock sample to be dropped in the acid after closing the cell. The cell's capacity is 482 ml. For testing acid 10 ml of acid and 10 ml of water are placed in the cell. *Ca* 2·5 g of $CaCO_3$ is put in the holder. After mixing the pressure is noted, and this is a measure of the amount of CO_2 formed, and hence of the concn of acid. The results agreed, on test, within 0·5% by wt of those obtained by titration.

The solubility of carbonate rocks in treating acid may also be found by this device. G. D. H.

397. A result of SP log interpretation. P. V. de Andrade. *J. Petrol. Tech.*, 1955, **7** (11), 59–60.—Wells producing only water from the Sergi sands in fields in the Bahian Reconcavo were used to compare resistivities obtained from *SP* logs with those obtained by chemical analysis of the waters. The upper part of the Sergi is medium to fine in grain, and has finely disseminated clay.

The *SP* was measured from the appropriate shale line. The ratio R_m/R_w was read from the right temp curve of Wyllie's chart, and R_w was calculated from the known R_m. The resistivities derived from the logs were too high, the 2 being related by $\log R_w = 0{\cdot}582 \log R'_w - 0{\cdot}748$. Wyllie's relationship is $SP = K \log (R_m/R'_w)$. A general relationship $SP = K \log (R_m/R_w) + AK \log (R_t/R_w)$ is derived from these, and it is concluded that Wyllie's e.m.f. is not the only force involved in *SP* measurements, and the other e.m.f. is probably due to the difference in concn of the connate water and the soln adsorbed at the clay surface. G. D. H.

398. Fluid mapper studies of mobility ratio. R. E. Cheek and D. E. Menzie. *J. Petrol. Tech.*, 1955, **7** (11), 49–52.—The fluid mapper has a base slab of dental stone in which are openings to serve as wells, and it is covered by plate glass leaving a space *ca* 0·03 inch thick. The edge of the area under test is sealed with clay and the mapper is immersed in liq in a shallow dish. Fluid in the space under test is displaced by other liq, suitably coloured to permit the sweep-out patterns to be observed. Injection is by a small pump. Methocel was used to prepare aq soln of different visc. For a quadrant of a 5-spot pattern the base slab was 10 × 10 inches, and for a direct line-drive 11 × 19 inches. Wells were ¼ inch dia. Photographic records were made.

With a visc ratio of $M = 1$, the 5-spot pattern had a 71·5% sweep-out efficiency, in close agreement with analytical studies and other model techniques. Sweep-out efficiencies ranged from 51·8% for $M = 0{\cdot}093$ to 89·1% for $M = 24{\cdot}4$. Rates ranged 0·028–0·112 cc/sec, giving reproducible results. The results for values of $M < 4$ agree with other experiments, but for higher values the present technique showed lower sweep-out efficiencies. It is difficult to fix the instant when the displacing fluid reaches the producing well.

For line-drive with $\frac{b}{a} = 2$, sweep-out efficiencies ranged from 58·7% for $M = 0{\cdot}089$ to 92% for $M = 24{\cdot}8$.

The technique is believed to have considerable potentialities. G. D. H.

399. Hydraulic model for the study of linear flow in porous media. M. Gaucher and M. Burmar. *Rev. Inst. franç. Pétrole*, 1955, **10** (9), 1057–72.—The expansion of a liq in a porous medium of constant cross-section at right angles to the pressure gradient can be simulated by a series of vessels of a given cross-section connected by capillary tubes, all of which are identical in length and bore. Equations are derived which link the expansion capacity and the transmission capacity.

A series of experiments is described, and the results are given for flow at a constant pressure gradient, flow with constant pressure at the outlet and no feed at the upstream end of the apparatus, flow at a constant rate from the outlet, and flow with diminished permeability near the outlet. Pressure build-up curves are also given.

Careful temp control is necessary.

The experimental data are compared with theoretical studies. G. D. H.

400. Elements of fluid mechanics in porous media. A. Houpeurt. *Rev. Inst. franç. Pétrole*, 1955, **10** (9), 1073–114.—After presenting various mathematical points, the cases of several different arrangements of wells are considered. The method of images is applied, as well as conformal transformations, and finally the problem of a well on a faulted anticline is examined. G. D. H.

401. Big Muddy water flood. R. W. Haller. *J. Petrol. Tech.*, 1955, **7** (11), 9–13.—The Big Muddy field is on an E.–W. fold with 300 ft of closure, and dips up to 20° on the N. flank and 2°–10° elsewhere. The main production is from the Second Wall Creek sand at depths of *ca* 3050 ft. The sand, with coarse and fine streaks, averages 90 ft in gross thickness. The principal source of energy was soln gas, with possibly some water drive on the N. flank. The initial pressure was *ca* 1320 p.s.i., and after giving 22,000,000 brl of oil the pressure was 50 p.s.i. The original gas–oil ratio was 350 cu. ft/brl. Some fresh water was produced from wells on the N. flank. Gas injection, started in 1935 when the field was 18 years old, was soon abandoned, in part because of apparent channelling. Primary recovery was estimated as 19%, or 175 brl/acre-ft.

Lakota water was found to be compatible with Second Wall Creek water, so no chemical treatment was needed for injecting the former. Lakota water was produced with oil from 2 wells with submersible centrifugal pumps. The W.-central part of the field was selected for a trial starting in 1953. The use of fluorescein indicated a high-permeability stringer between the injection well and a neighbouring well, but another showed increased output, and in 2 years gave over 51,000 brl of oil by flooding, while another gave 44,500 brl. Others showed minor oil production increases.

The initial water input was 5500 b.d., falling with fill-up to 1025 b.d. in Aug. 1954, and then rising to 3400 b.d. by using additional input wells. Before water flooding 19 wells in the trial area averaged 162 b.d., 20 months later they averaged 670 b.d., and now they average 870 b.d. Cumulative oil production by water flooding is 351,967 brl (1 May 1955), cumulative water injection 1,564,413 brl, and cumulative water output 389,964 brl. $65,033 has been spent on developing the flood over 600 acres. At present operating costs are 38 c/gross brl.

Connate water saturation was 25·5%, residual oil saturation 55·3%, and water-flood residual saturation 30%. G. D. H.

402. Well stimulation in the Pembina area cardium reservoir. S. M. Thorne and P. K. Fleming. *Canad. Min. metall. Bull.*, 1955, **48** (523), 746–51.—The Pembina field, now over 2 years old, has confirmed substantial cardium sandstone oil reserves. Well stimulation of this particular formation is discussed and future trends are indicated. Operations have presented numerous problems, and a specific treatment programme is desirable.

The cardium sandstone is a "proving ground" for well stimulation treatments in Canada, and the evaluation of formation fracturing is of paramount importance.

In conclusion, the authors state that completions of cardium wells presently fall into 2 categories, namely cased-through and barefoot. Arguments for and against both methods continue. Much experimental work is being done on formation fracturing, and present fracturing treatments reflect the results of data obtained to date. The use of mud-acid in the cardium sandstone is being watched very carefully and, in conjunction with this, the value of surfactants is being investigated. 5 figs. M. P. T.

403. Well stimulation in the Smiley and Provost Viking Sand reservoirs. M. M. Hanna and J. G. Riley. *Canad. Min. metall. Bull.*, 1955, **48** (523), 752–3.—Production stimulation in the Smiley and Provost Viking Sand reservoirs has been confined to fluid fracturing and mud clean-out acid treatments. Of the 2 methods, fluid fracturing, using oil as the carrying medium and sand as the propping agent, has proved particularly effective. Details of sandfaces and production figures are given.

Mud clean-out acids have been used with varying success in the Smiley pool. It appears that mud-acid treatments are successful only in those sands which are severely affected by drilling fluids.

In conclusion, the authors state that large sandfrac treatments of up to 40,000 lb can be successfully carried out on thin sand sections, and will materially increase productivities on properly selected wells. 3 figs. M. P. T.

404. Observation wells at Lacq. R. Gayral. *Rev. Inst. franç. Pétrole*, 1955, **10** (5), 377–86.—Lacq, discovered in 1949, produces from the Senonian at 600 m beneath Aturian marly limestone. A 140-m oil column is tapped by wells 500 m apart on a square pattern. The reservoir rock is a fractured dolomitic limestone in the central area, with non-fissured porous limestone at the edges. Porosity ranges 1–30%. Some fissures are several mm wide. The initial oil–water contact in the fissures was 30 m lower than in the matrix. No gas cap exists, the bubble point is 11 kg/cm², and production is by water drive. Wells completed in the fissured zone are the best, La 4 having a productivity index of 1800 m³/day/kg/cm². With cumulative production 1,400,000 m³ in Jan. 1955, the pressure had dropped 1·6 kg/cm² from the initial value of 61·25 kg/cm². Production by expansion is negligible, and wells have been drilled to observe the rise of the water. One is in the centre and 2 at the edges of the field, and 4 poor wells have been deepened for observation.

The relationships of observation and producing wells are discussed for the cases where one or both penetrate fissures in the oil or in the water zones. A rise in water level may cause a change in the relationships.

The behaviour of the various observation wells at Lacq over time is given, and the significance of this behaviour is discussed. Some are seen to be in areas which are not being effectively drained by existing wells. G. D. H.

OILFIELD DEVELOPMENT

405. East Texas: 25 and going strong. R. J. Enright. *Oil Gas J.*, 3.10.55, **54** (22), 78.—The discovery and development of the E. Texas field is reviewed, and it is estimated that it has another 30–40 years producing life. The field was discovered in 1930, and to Oct. 1955 it had produced 3,200,000,000 brl. 20,200 wells are currently producing, and *ca* ½ of these are flowing.

The structure is a stratigraphic trap, 43 miles long, and production comes from the Woodbine sand under water injection. Edge water encroachment threatens to divide the field into 3 parts, and over the past 5 years *ca* 375 wells each year have been drowned.

Current production is *ca* 270,000 b.d. C. A. F.

406. New approach adds impetus to Pennsylvania's deep drilling. C. Roberts. *Oil Gas J.*, 31.10.55, **54** (26), 163.—Hydraulic fracturing and air drilling have stimulated deep exploration and development drilling in Pennsylvania. Main areas of interest are Clearfield, Jefferson, and Indiana counties, where gas is produced from 7000–7500 ft in the Onondaga chert, which is dry or has only small shows before treatment.

A major gas field has been developed in the chert in recent years in SW. Pennsylvania, and it is expected that large reserves will be developed in this formation in these central counties. C. A. F.

407. Ten years of activity of the Polish petroleum industry. J. Drzewiecki. *Nafta* (*Krakow*), 1954, **10**, 152–7.—The author presents a brief summary of achievement of the years since 1945 under 9 headings. In the realm of geology more modern methods were applied to determine the structure of Carpathians with the general aim of locating further oil sands. Drilling has changed radically from percussion to rotary. Initially the ratio was 10 : 1, and now it is 1 : 2, whilst the total increased tenfold. Average depth of wells increased to reach older deposits, and geological and exploratory drillings are at par with productive drilling. Education and new factories were making their contributions, but economies in steel pipes were necessary. Oil production doubled itself between 1945 and 1952 and then fell slightly. New methods were used, *e.g.* flooding, shooting, and repressurizing. Centralization of the industry has led to several improvements. Production of stabilized gasoline rose due to expansion of stripping plants, and natural gas production has been doubled by discovery in 1953 of new high pressure fields. Pipes have been laid between the oilfields and several towns, including Warsaw. New factories, mainly directed towards production of rotary drilling equipment, have sprung up under the 3-year and 6-year plans. Power used in the fields has changed to electricity. Investments in the industry were aimed at the above objectives and at improvements which benefited the operatives. The organization of the industry was unified in 1949 under drilling, production, refining, equipment, and planning departments. More recently the last 2 were separated from the petroleum industry, and refining has been enlarged to equal the other 2 together. This illustrates the present trend in Polish petroleum industry, but need not be permanent. M. S.

TRANSPORT AND STORAGE

408. Ductile iron—a new material for petroleum pipe. M. Grandpierre and C. C. Reynolds. *Oil Gas J.*, 21.11.55, **54** (29), 192.—The mechanical and anti-corrosion properties are given of ductile iron for pipelines. The iron has a high resistance to corrosion, and compared with cast steel has better surface finish, flexibility of heat treatment, and machinability. G. A. C.

409. Operation of compressor cylinders without cooling water. J. L. Gallagher and E. W. Evans. *Pipe Line News*, 1955, **27** (10), 37–9.—After 2 years of operating gas compressor plant without water cooling no loss of efficiency or increase in wear on equipment was experienced. It can be shown that if high temp cooling water is used, there is little cooling of the gas. B. A. F.

410. Volume shrinkage in pipeline blending. H. M. Childress and M. B. Grove. *Oil Gas J.*, 21.11.55, **54** (29), 178.—The theory of volume shrinkage is discussed, and lab and field data on the magnitude of the volume change on mixing light components in a crude oil correlated. Effect of pressure, crude base, and temp and sequence blending are taken into account. G. A. C.

411. Pipeliners like push-button station control. E. B. Turner. *Oil Gas J.*, 28.11.55, **54** (30), 85.—A survey of remote supervisory control equipment shows 50 stations in use and future plans for another 35. Results have been most satisfactory, equipment being reliable and reasonable in cost. Design trend is toward transmission of less detailed information to operator. G. A. C.

412. Batching natural gasoline through crude oil pipelines. C. N. Adams. *Pipe Line News*, 1955, **27** (10), 40–2.—Contamination was initially experienced in pumping 25,000–50,000 brl batches of natural gasoline through crude oil pipelines. The lines were thoroughly cleaned of solidified waxes by running scraper brushes through 24 hr, 4 hr, and 1 hr prior to despatching the gasoline. Interfacial mixing was reduced by a high throughput and a thorough check of valves, station pumping lines, etc., revealed further sources of contamination. Improvement in operating techniques and methods reduced batch contamination to 5%. B. A. F.

413. A users evaluation of microwave. C. E. Upson. *Pipe Line News*, 1955, **27** (10), 45–52.—Operation of a network of 1090 miles of microwave communication system has shown the reliability and flexibility of the method. It is essential to back up the system with adequate maintenance facilities for both pipeline and communications. B. A. F.

414. How to design a gas pipeline. S. D. Ford. *Oil Gas J.*, 12.12.55, **54** (32), 106.—Factors in design compution and estimating economies for 2 different pipeline systems are described. Correct spacing of compressor stations and size and weight of pipe are important points for consideration. G. A. C.

415. Hydraulics for pipeliners. C. B. Lester. *Pipe Line News*, 1955, **27** (6), 35–40; **27** (7), 27–31; **27** (9), 39–44; **27** (10), 24–30.—Reference is made to the standard codes in determining the allowable working stresses in pipelines.

With the use of large dia pipelines, the "telescoping" or decreasing of the pipe wall thickness with decreasing pressure, and "grade-tapering," the use of lower strength materials with decreasing pressure, has become important. The principles are illustrated numerically.

Pt XIII is an introduction to the theory of pressure surges in oil pipelines.

Pressure surge theory is developed for the case of a real liq in a long pipe such that there is no reflection of the pressure wave. Graphical soln due to Ludwig and Johnson, and Angus are particularly useful and are accurate for nearly all pipeline work. B. A. F.

416. Modernized and simplified methods for controlling pump stations automatically. R. J. Thompson and T. H. Puckett. *Pipe Line News*, 1955, **27** (11), 25–7.—It would be more economical and simple to build up pumping station electrical control systems from standard, mass-produced units designed to perform an alarm or shut-down function, a sequence operating and checking function, and a timing function. Circuits that fulfil these objectives have been designed on the basis of a survey of existing needs of electrical equipment for automatically controlled stations. B. A. F.

417. What size anodes should you use? Y. W. Titterington. *Pipe Line News*, 1955, **27** (11), 49–50.—An economic study of the relation between number, size, type, and installation cost of various types of anodes and the resistivity of the soil. B. A. F.

418. Texaco rides a spreading trend: products pipelines. Anon. *Nat. Petrol. News*, 1955, **47** (12), 106–8.—The Texas Co are saving $3 million p.a. in transport charges as a result of building 16 products pipeline terminals and converting 3 from water service in the past 2 years. 7 figs. M. P. T.

419. Yellowstone pipeline. N. B. Marvis. *Pipe Line News*, 1955, **27** (11), 20–4.—A description of the design, construction, and operation of the 530-mile long pipeline. B. A. F.

420. Baiji–Baghdad pipeline. Anon. *Fluid Handl.*, 1955, 311–15, 352–3.—Route, construction, and laying of 132-mile pipeline carrying "tailored" crude from K2 pumping station of Kirkuk–Banias line to Baghdad refinery are described and illustrated. The 12-inch line has capacity of $>10^6$ tons/year of crude and crosses the Wadi Tharthar depression, where it will be submerged at periodically changing depths in flood water drawn from the River Tigris. B. S. W.

421. Fabrication and laying of submarine oil loading lines at the port of Mina-al-Ahmadi, Kuwait. Anon. *Trans. Inst. Mar. Engrs*, 1955, **67** (10), 378.—The construction of 3 additional submarine line berths at Mina-al-Ahmadi is described in detail. T. T.

422. Paint storage tanks white—and save. E. L. Hoffman. *Oil Gas J.*, 21.11.55, **54** (29), 241.—Data on tank paints reviewed for several types of tanks and data summarized in the tables. Self-cleansing white paint reduces evaporation losses. G. A. C.

423. Tank foundations for weak soils. J. R. Sellers. *Oil Gas J.*, 5.12.55, **54** (31), 132.—Satisfactory use by Phillips Petroleum Co of 3 foundation designs at the Freeport terminal is described. Methods include concrete mat with piling, concrete ring with piling, and crushed rock fill. G. A. C.

424. Design and selection of storage tanks. W. E. Jook. *Oil Gas J.*, 14.11.55, **54** (28), 170.—Design and economics are considered in choosing between cone- and floating-roof tanks, and in selection of a particular type of floating roof. Nomograms are given for fine vapour pressures of various gasolines. G. A. C.

425. Minimum weight cylindrical pressure storage tanks with elliptic or hemispheric base. V. G. Chibaeff. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1284–94.—Mathematical discussion of vessel wt reduction by selecting optimum ratio of length to dia for given design pressure and capacity. Such optimum

ratio corresponds to minimum wt of vessel or its stainless steel lining. Practical applications include: vessels with low or medium design pressure and shell thickness exceeding that calc; stainless steel-lined vessels; stainless steel vessels with no additional thickness allowance for corrosion; vessels designed for high pressure and large capacity.
(Author's summary.)

426. Refuelling aircraft. A. J. Clements. *Fluid Handl.*, 1955, 302–4, 340–2.—Problems encountered in speedier refuelling of commercial and military aircraft are considered. Typical ground installations for delivery of fuel at high pressure to hydrants are illustrated, and advantages of the vertical centrifugal pump for delivering up to 250 g.p.m. of fuel at pressures above 100 p.s.i. are discussed. B. S. W.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

427. Sun Oil's new water re-use system. H. F. Elkin. *Oil Gas J.*, 12.12.55, **54** (32), 88.—The initial operation of a new process revision to the water supply and waste disposal system at Sun Oil Co's Toledo refinery is described. The system includes comprehensive pollution control of all plant waste waters, max reclamation of spent water for re-use in the refinery with minimum of pretreatment, and practically unlimited water for emergency fire protection. G. A. C.

428. How liquid type dust scrubbers clean gas. J. M. Campbell. *Oil Gas J.*, 12.12.55, **54** (32), 90.—This is No. 8 in the series and deals with separation of dust and entrained liq from gas, characteristics of liq scrubbers, and how to eliminate carry-over. G. A. C.

429. The Dura refinery at Baghdad. Anon. *Petrol. Times*, 23.12.55, **59** (1523), 1308.—Crude oil supply, refining process, motor spirit and kerosine treating, tankage, water supply, and ancillary equipment such as fire protection system of the Iraq Government Oil Refineries Administration are described. G. A. C.

430. Kwinana: largest Australian refinery opened. Anon. *Petrol. Times*, 25.11.55, **59** (1521), 1201.—A series of articles deal with the new 3 million tons p.a. refinery recently completed for the British Petroleum Co at Kwinana, W. Australia. How the site came to be chosen, the men who built Kwinana, the planning, description of the oil processing units which include 2 atmosphere dist units each of 35,000 b.d. capacity, a 24,000-b.d. vacuum dist unit, a Platformer, a 12,500-b.d. Orthoflow fluid cat cracker, a hydrofiner, a bitumen-manufacturing plant, and 5 copper chloride treating plants, are described. Tankage and distribution of products, essential services and fire protection, and a description of the new town are the subjects of other articles in the series. G. A. C.

431. Development of refining industry in reborn Poland. S. Sukranowski and L. Zukrowski. *Nafta* (*Krakow*), 1954, **10**, 157–9.—Before the war investments were very small and the industry backward. German Forces ruined and dismantled most works before withdrawing. Between 8 Sept. 1944, when first refinery was recaptured, and 1948, production reached and exceeded 1938 production. The 6-year plan aimed at introducing modern methods and increasing production of high-grade lubricants. Extensive teaching plans provide skilled operatives, and various benefits encourage recruitment of labour. Changes in the organization in the refining industry reflect its rapid growth. M. S.

DISTILLATION

432. Automatic control of distillation. A. Crico. *Chim. et Industr.* (*Génie Chim.* suppl.), 1955, **74**, 138–48.—Discussion of factors involved, with graphical study based on system CH_3OH–H_2O. Numerous schematic diagrams of control systems, with particular reference to pressure control. Mathematical discussion of control system dynamics. V. B.

433. Separation of aromatics by extractive distillation. S. Niementowski. *Bull. Polish Inst. Petrol.*, 1954, **4**, 8 (suppl. to *Nafta* (*Krakow*), 1954, **10**).—Work on artificial mixtures of 115°–111° C cut and toluene using cresol, phenol, and furfurol. M. S.

434. Automatic control in continuous distillation. A. Rose and T. J. Williams. *Industr. Engng Chem.*, 1955, **47** (11), 2284–9.—An electrical analog computor was used to analyse the suitability of data from various sampling points being used as a means of automatic control for a 5-plate column receiving a feed of varying composition. Adequate control could be maintained with top plate or intermediate plate single-point sampling or by using top plate and bottom plate 2-point sampling. A combination of proportional and integral control was found effective for these types of sampling. It was found that the use of dist samples for controlling was to be avoided, since the delay in the condenser lines caused controller-column instability for all but the smallest values of gain. The best control was obtained by the use of top plate samples. B. A. F.

435. Design for flexibility. A. M. L. Kube and R. H. Stone. *Oil Gas J.*, 5.12.55, **54** (31), 106.—The Dumas gasoline plant belonging to Phillips Petroleum Co operates fully loaded at 210 M.M. c.f.d. during winter months and only 90 M.M. c.f.d. during the summer. Process flow, compressor system, fire fighting equipment, and special instrumentation are dealt with. G. A. C.

ABSORPTION AND ADSORPTION

436. Two-stage distillation and two-stage reabsorber system. W. E. Banner. *Oil Gas J.*, 12.12.55, **54** (32), 85.—A description is given of the Midkiff natural-gasoline plant which processes 167,000,000 cu. ft/day of casinghead gas, the propane recovery exceeding 550,000 gal/day. The main absorbers operate at 695–825 p.s.i., with 2 stages of reabsorption and a 2-still dist system. G. A. C.

CRACKING

437. Iso-plus, new process for manufacture of 100, or over, octane gasoline. H. Heinemann *et al.* *Bull. Ass. franç. Tech. Pétrole*, 1955, 535–51.—E. Texas 50 F_1 naphtha is Houdriformed to 87 F_1, depentanized, aromatics solvent-extracted; raffinate is then further Houdriformed and reformate blended with aromatics and $C_4 + C_5$ to give 100 F_1, 10 RVP product at 91 vol % yield. Alternatively, aromatic-free raffinate can be recycled to reforming stage, to yield 79 vol % 100 F_1 with very much simpler equipment (only one Houdriforming stage instead of 2). To obtain higher O.N. first process can be modified by recycling second stage reformate to solvent extraction section and recycling raffinate therefrom to second stage Houdriforming, yield 82·5 vol % of 108 F_1. Schematic flow diagrams and yield–octane charts are given. V. B.

438. Recovery of catalytic cracking stock by solvent fractionation. P. H. Johnson *et al.* *Industr. Engng Chem.*, 1955, **47** (8), 1578–85.—The high demand for light oils and the low demand for fuel oils and residua have made it economical to process vacuum dist residua to produce feed stock for cat cracking. "Deep" vacuum flashing is comparatively un-

selective in producing cracking stocks. A pilot-scale study has shown that by the choice of a suitable light hydrocarbon as solvent and judicious selection of temp, pressure, and solvent–oil ratio, solvent fractionation of residua increases the volume and quality of the cracking stock produced. A comparison of the products of cracking stocks produced by solvent fractionation and deep vacuum flashing showed the superior quality of solvent fractionation stock. B. A. F.

439. Coke formation and its relationship to cumene cracking. C. J. Plank and D. M. Nace. *Industr. Engng Chem.*, 1955, **47** (11), 2374–9.—The cat cracking of cumene is useful in characterizing cracking cat. The effect of coke formation on cumene cracking was studied, and it was found that coke is only indirectly connected with the rate of cracking. Coke formation and cracking are inhibited by cpds present in the cumene charge, and these inhibitors may be cumene hyperoxide or at high temp its decomposition products, or styrene or methylstyrene. The relative adsorption equilibrium constants can be calculated from their inhibiting effect on cumene cracking. B. A. F.

CHEMICAL AND PHYSICAL REFINING

440. Treating distillates by electrical precipitation. R. J. Phillips. *Oil Gas J.*, 5.11.55, **54** (31), 116.—Use is described of electrical precipitation for treating of dist from naphtha to lub oil boiling ranges with such agents as caustic soda and acid. Process is outlined and variables considered, and comparison made with gravity settling method. G. A. C.

METERING AND CONTROL

441. Automatic control of fractionating columns. O. D. Larrison, F. W. Paul, and H. H. Harris. *Oil Gas J.*, 5.12.55, **54** (31), 123.—The differential refractometer, as used by Phillips Petroleum Co, is described. It has almost unlimited applicability to gasoline fractionators. General applications include large-scale manufacture of gasoline blending components, and the separation of *cyclo*hexane–methyl*cyclo*pentane. Maintenance of the instruments is also described. G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

442. Properties of high molecular weight hydrocarbons. R. W. Schiessler and F. C. Whitmore. *Industr. Engng Chem.*, 1955, **47** (8), 1660–5.—The densities, visc, b.p., m.p., refractive indices, analine and furfural points, and other derived properties are given for 207 synthetic hydrocarbons (C_9 to C_{30}) of high purity. B. A. F.

443. Measurement and correlation of vapour pressure data for high boiling hydrocarbons. H. S. Myers and M. R. Fenske. *Industr. Engng Chem.*, 1955, **47** (8), 1652–8.—Vapour pressure data for hydrocarbons at pressures below 10 mm Hg is scarce and unreliable. An apparatus was built and used to measure the v.p. of high b.p. hydrocarbons for pressures in the range 0·1 mm Hg to atmospheric. Vapour pressure–temp data for 26 hydrocarbons of varying molecular structure was obtained and correlated on a single chart. B. A. F.

444. Vapour pressure chart for all types of low boiling hydrocarbons. H. S. Myers. *Industr. Engng Chem.*, 1955, **47** (8), 1659–60.—Vapour pressure data for all types of low b.p. hydrocarbons have been correlated on a single chart. The normal b.p. was plotted against the b.p. at various other pressures from 1 mm Hg to the critical pressure. Data for nearly all hydrocarbons are accurate to within 5° F. B. A. F.

445. Optimum reflux ratio for fractional liquid extraction. E. G. Scheibel. *Industr. Engng Chem.*, 1955, **47** (11), 2290–3.—The use of reflux in 2-solvent fractional liq extraction decreases the number of stages required and hence decreases column height. Subject to a max allowable solute concn, the quantity of solvent required is increased, and this increases the cross-sectional area of the column. A method for defining the optimum reflux ratio is compared with the reflux ratio requiring minimum column volume. An equation is derived for calculating the reflux ratio in an ideal system and is applied to a non-ideal system. Saving in the non-ideal system is smaller than in the ideal system. B. A. F.

446. Industrial application of molybdenum chemistry. Various. *Industr. Engng Chem.*, 1955, **47** (8), 1492–516.—B. H. Danziger (pp. 1495–500) reviews the wide use of molybdenum as a cat for oxidn, hydrogenation, dehydrogenation, isomerization, cyclization, chlorination, and condensation reactions. Amongst the principal applications of molybdenum cat are the reforming of straight-run naphthas, the desulphurization and upgrading of petroleum stocks, and the hydrogenation of coal and shale oils. B. A. F.

447. Information on the physicochemical principles of recovery and decomposition of phenol fractions from coal tar and brown coal-low-temperature-carbonization tar. E. Terres *et al.* *BrennstChemie*, 1955, 36 (23–24), 359–72.—Communication VII. Investigations of the ternary solvent systems of phenol and phenol derivatives with water–methanol mixtures, and their critical soln temp. Investigation of ternary solvent systems of C_6H_5OH and 27 derivatives with H_2O–CH_3OH mixtures of varying concn is presented. Results are given in tables and curves with curves of the binary system C_6H_5OH or derivatives with H_2O inserted for comparison. Data in binary groups (communication VI), re No. and position of substituents (CH_3–, C_2H_5–, and C_3H_7–), recur in ternary systems. Thus, solubility decreases with approach of substituent or substituents to the OH-group in the order *p*-, *m*-, and *o*-position. With increasing concn of CH_3OH the differences diminish, becoming zero at sp concn of CH_3OH for isomeric phenol cpds. The No. of alkyl groups per mol increases the hydrophobic character of the phenol derivatives concerned. With all the derivatives C_6H_5OH solubility is increased and crit soln temp lowered with increasing CH_3OH cont of solvent. Relations and regularities exist between solubility and crit soln temp within homologous series on the one hand, and dielectric const, dipole moments, sp susceptibility, and b.p. Results from f.p.-curves indicate formation of trimethyl phenol—CH_3OH—adducts with trimethyl phenols. Graphs of crit soln temp against CH_3OH cont of solvent show that, with increasing CH_3OH cont up to 25 wt%, the crit soln temp of each phenol lies on a straight line with the crit soln temp of pure H_2O as limiting val. This permits extrap of val for phenols with high crit soln temp. At high CH_3OH cont of solvent the lines of isomeric C_6H_5OH-derivatives converge progressively and unite at a definite CH_3OH cont. The curves of all C_6H_5OH-derivatives converge at *ca* 70 wt% CH_3OH in the H_2O–CH_3OH mixture and corresponding temp. R. T.

ANALYSIS AND TESTING

448. Rapid chromatographic method for the determination of impurities in ethylene. N. H. Ray. *Analyst*, 1955, **80**, 853–60.—Simplified chromatographic method for determination of small amounts of non-olefinic impurities (other than CO_2) in C_2H_4 has been developed. Ethylene is absorbed from a measured sample by passing it over Br-impregnated charcoal, and the impurities that remain are analysed by elution from a short column of activated charcoal in a current of CO_2. The fractions are collected and measured in a nitrometer over KOH soln. (Author's abstract.)

449. Reagent for sulphur dioxide. H. F. Liddell. *Analyst*, 1955, **80**, 901.—Detection of SO_3 in air in presence of H_2SO_4 can be made a roughly quant estimation by finding the volume of air needed to bleach Astrazone Pink F.G. (Bayer) soln to pre-determined extent. Only gas-sampling pump and plastic filter paper holder are required. Concn of 1·5 μg of SO_2 in 500 ml of air will give definite qual reaction. B. S. W.

450. Test for pitch and bitumen. A. D. Baynes-Cope. *Analyst*, 1955, **80**, 839–40.—Presence of pitch or bitumen in as little as 10–50 μg of unknown samples can be detected by paper strip chromatography on Whatman No. 4 paper. After elution by toluene, then dry CH_3OH, examination of the paper under u.v. light indicates the presence of coal-tar pitch, bitumen, and mineral grease or oil. Modification of the test will allow estimation of small amounts of bitumen in 1 mg of coal-tar pitch. B. S. W.

451. Identification of fuel oils polluting coastal waters. J. K. Johannesson. *Analyst*, 1955, **80**, 840–1.—Identification of 3–5 g samples of fuel oils is carried out by ashing of sample followed by determination of V and Ni. Example illustrates identification of sample by comparison of V and Ni contents with those of suspect source. B. S. W.

452. Determination of *cyclo*pentadiene and maleic anhydride. P. Unger. *Analyst*, 1955, **80**, 820–4.—*cyclo*Pentadiene or maleic anhydride can be determined by means of each other since carbic acid (the product of hydrolysis of the adduct of *cyclo*pentadiene and maleic anhydride) reacts quantitatively and rapidly with K bromate–bromide in acid soln to form the di-bromo-derivative. After addition of KI the liberated I is titrated with standard $Na_2S_2O_3$. Determinations take 30–40 minutes and, with some exceptions, results are accurate to $< \pm 0{\cdot}3\%$. B. S. W.

453. Resistivity test for insulating oil. A. W. Stannett. *Elect. Times*, 1956, **129**, 43–5.—Experience of C.E.A. with resistivity test (Forrest, *J. Instn elect. Engrs*, 1948, **95** (II), 337) is summarized. General correlation between resistivity and acidity, 1 mg KOH/g corresponding to $0{\cdot}2 \times 10^{12}$ ohm-cm/70° C. If low resistivity is due to suspended H_2O, then resistivity rises with increasing temp, contrary to what is found with other contaminants. Crackle test can fail to detect H_2O at *ca* 50 ppm whilst lower limit is 15 ppm which is approx max permissible H_2O content for insulating oil. Resistivity test gives max information for single test on used oil; for new oil this test is preferably carried out in lab, not plant, conditions. Certain inhibitors, *e.g.* phenyl-β-naphthylamine, decrease resistivity by factor of 5–10. V. B.

454. The international standardization of measurement and testing. Anon. *Petrol. Times*, 9.12.55, **59** (1522), 1274.—British contribution to the work of the International Standards Organization TC28 is reviewed. Subjects include petroleum measurement engine test methods and the future of the Organization. G. A. C.

455. Deposit analyses in lubrication problems. P. B. Burgess and J. F. Wygant. *Lubric. Engng*, May 1955, **11** (3), 193–7.—The value of deposit analysis in indicating causes of lubricant or metal breakdown is stressed, and a comprehensive system of analysis is presented covering both organic and inorganic cpds, special emphasis being laid on petrographic, spectrographic, and X-ray diffraction methods. J. G. H.

456. Testing procedure for apparatus of the pressure-resistant-casing type, protected from explosion. H. Busch. *Brennst-Chemie*, 1955, **36** (23–24), 373–5.—3 methods given in spec VDE 0170/0171, par 56e, for testing the safety of ignition penetration in deformation are discussed. A proposed fourth method is described, which excludes the disadvantages of these procedures. R. T.

ENGINE FUELS

457. Fuel oil additives. N. Seely. *Sci. Lubric.*, 1955, **7** (10), 19–20.—The functions of fuel oil additives in rendering innocuous the products of incomplete combustion and in overcoming difficulties occasioned by the depletion of detergent additives in the lub oil used, with consequent extension of periods between overhauls, are discussed. J. G. H.

458. How to make your own 100 octane. F. D. Buerstetta and T. W. Warren. *Oil Gas J.*, 21.11.55, **54** (29), 142.—Tests are given showing how pure hydrocarbon types can best be blended for max O.N., by establishing the relative contribution of the 4 hydrocarbon types to engine anti-knock behaviour, and relating such behaviour to the variables such as research or motor O.N. or both, fuel anti-knock quality level, and TEL concn. G. A. C.

GAS OIL AND FUEL OIL

459. Progress Review No. 36 : the characteristics of oil fuels. C. W. G. Martin. *J. Inst. Fuel*, Nov. 1955, **28** (178), 560.—The nomenclature of "heavy petroleum fuels" is discussed. Aspects considered are: factors which influence fuel characteristics, *e.g.* origin, climate, economics, application, etc; the conventional grades and their evolution; the control of quality; future prospects. D. K.

460. 5 ways to sell builders on oil heat. C. Broderson. *Nat. Petrol. News*, 1955, **47** (11), 93–5.—Although oil heat systems are generally costly to install, they cost less than gas to operate. Builders should therefore be made aware of the advantages of oil heat and be given expert technical advice. The article deals with U.S. practice. M. P. T.

461. Brick kiln fuels. C. Padovani. *Riv. Combust.*, 1955, **9** (11), 853–74.—Statistics are given on the consumption, types, and diversity of fuels used in Italian brick kilns. With the Hoffmann ovens, which are the most widely used type of kiln installed, efficiency varies widely, ranging in rationally-built ovens from a minimum of 265 to a max of 360 kcal/kg of end product. There are various methods for raising the output, the most efficient being complete utilization of the sensible heat from discharge fumes. Gaseous fuels (methane or natural gas) and liq fuels (fuel oil) enable Hoffmann oven operating costs to be cut, beside offering other practical advantages. Availability of high-calorie fluid fuels with stable characteristics might stimulate the gradual replacement of Hoffmann ovens by fixed flame or moving load (tunnel kilns) types which are built and operated on more rational principles. In forthcoming years the brick industry will be able to count on having large quantities of natural gas and fuel oil available. It is calculated that during the next 5 years 20% of the brick industry's heating requirements can be covered by gaseous and liq fuels. (Author's abstract.)

LUBRICANTS

462. Industrial lubrication engineering in the U.S.A. G. D. Jordan. *Sci. Lubric.*, 1955, **7** (7), 12–19.—Impressions gained during a 3 months tour of the U.S.A., visiting plants, mainly steelworks, in order to study lubrication procedures are recorded. Advances in the status of lubrication engineers accruing from the centralization of lubrication activities are remarked upon and the place of the lubrication engineer in the general maintenance programme discussed, together with duties from the standpoints of records, inspection, testing, training, selection and purchase of lubricants, and the design of equipment for satisfactory lubrication. The predominance of automatic lubrication systems and the increasing use of hydrostatic lubrication are noticed. J. G. H.

463. Sliding friction test for metalworking lubricants. W. J. Wojtowicz. *Lubric. Engng*, May 1955, **11** (3), 174–7.—A simple sliding friction test, being a modification of the Heinz friction test, for the evaluation of lubricants used in drawing, stamping, and forming is described. Measurements are made at speeds of the order of 4 inches/min and at pressures of 5000–10,000 p.s.i. Flow of metal is correlated with average kinetic coeff of friction and welding with progressive increase of friction force. Tests carried out on a wide range of metals and lubricants indicate good agreement with data from production tests and from previous investigations. J. G. H.

464. Maintenance of water-soluble machining coolants during use. J. A. Prevel. *Lubric. Engng*, May 1955, **11** (3), 178–9.—Increasing use of water-soluble cutting oils has rendered necessary steps to ensure their max efficiency. In addition to normal routine for plant cleanliness, frequent aeration of the emulsion and checks on concn and pH values are desirable; the latter should not be allowed to drop below 7. Causes of rancidity and offensive odours should be identified and eliminated. J. G. H.

465. Effects of sliding velocity and temperature on wear and friction of several materials. R. L. Johnson, M. A. Swikert, and E. E. Bisson. *Lubric. Engng*, May 1955, **11** (3), 164–70.—Data are presented on a series of investigations conducted at N.A.C.A. Lewis Flight Propulsion Lab, rendered necessary by the increasing importance of wear or surface failure tendencies of materials for cages or retainers for rolling contact bearings as used in the development of aircraft turbine engines. Wear was evaluated by sliding leaded brass, iron–silicon–bronze, cast Inconel, and nodular irons against hardened steel, with varying sliding velocities and temp. Apparatus and procedure employed are described in some detail, and the results tabulated indicate Inconel and nodular irons as the most promising materials. J. G. H.

466. Selection of equipment for successful operation of a new grease plant. O. L. Yarham. *NLGI Spokesm.*, March 1955, XVIII (12), 8–28.—The effect of suitable modern equipment in the economic functioning of a grease plant is emphasized, and advice is given on the selection of the essential components of the plant. Those covered include grease kettles, with motor drive gearing, scrapers and agitators calling for special attention, heat transfer and soap-forming units, grease pumps, milling and de-aeration equipment, filters, temp measuring instruments, continuous plants for special products, and general materials handling devices. J. G. H.

467. Some aspects of bearing lubrication. L. Berner. *Sci. Lubric.*, 1955, **7** (7), 20–3.—Factors governing the period during which grease-lubricated bearings may operate before requiring relubrication are enumerated and graphs indicating lubrication periods under normal conditions for ball, roller, and spherical roller bearings are presented, together with practical data on grease lubrication under special conditions. The advantages of oil circulating systems as compared with oil bath lubrication for bearings are set out, and the main oil mist lubrication systems are described and illustrated. J. G. H.

468. Rheological studies on the syneresis of lubricating greases. B. Yamaguchi, T. Oki, and H. Kageyama. *NLGI Spokesm.*, Feb. 1955, XVIII (11), 8–13.—Details are presented of a Japanese investigation into the relations between creep and syneresis in a gel system. The apparatus and methods used are described in some detail, and it was found that the syneresis curves of lub greases can be accurately expressed by the theoretical equation of creep for the generalized Voigt model, and that the syneresis index obtainable from the syneresis curve is a measure of the initial rate of syneresis. For greases thickened with the same gelling agent a straight line relationship holds between ASTM penetration and the log value of syneresis index, and no definite connexion appears to exist between ultimate oil loss and ASTM penetration. J. G. H.

469. "All-season" motor oil. F. di Mento and L. Lionessa. *Sci. Lubric.*, 1955, **7** (5), 30–2, 34.—Details are presented of work carried out at the Fiat lab on the formulation of a multigraded oil covering SAE grade 10W/20W/20/30 based on an additive comprising a conc soln of acrylic polymers. J. G. H.

470. Additives in lubricating oils. E. G. Curphey. *Sci. Lubric.*, 1955, **7** (7), 24–9.—The structure of lubricants and the operating conditions generally encountered are briefly surveyed and the composition and effect of V.I. improvers, pour point depressants, and corrosion inhibitors are discussed, together with oiliness agents, E.P. lubricants, and special additives for cutting oils. J. G. H.

471. Reclamation of used oils. 5. Cutting oils and coolants. E. G. Ellis. *Sci. Lubric.*, 1955, **7** (5), 19–25.—The special conditions obtaining in reclamation of cutting oils and coolants by reason of the recovery value of the contaminating metal material are outlined, and details of both batch and continuous treatment presented, together with the use of magnetic filters for the recovery of metal from grinding fluids and the special equipment used for the recovery and clarifying of paraffin type cooling fluids. J. G. H.

472. Lubricants for wiredrawing. A. L. H. Perry. *Sci. Lubric.*, 1955, **7** (5), 14–18.—Machinery and dies used for wiredrawing are described, the function of the lubricant in the wiredrawing operation is explained, and the value of maintaining, wherever possible, completely hydrodynamic conditions in order to reduce die wear is emphasized. Lubricating practice and pretreatment of steel, copper, and aluminium for wiredrawing are discussed in some detail. J. G. H.

473. Centralized lubrication on overhead cranes pays dividends. N. Errington. *Sci. Lubric.*, 1955, **7** (9), 22–4.—Operating data are presented on centralized lubrication on overhead cranes in a steel melting shop over a period of 6 months. Advantages accruing from substitution of centralized for manual lubrication included marked economy in oil consumption and reduction of time spent in lubrication, with consequent increase in crane availability. J. G. H.

474. Lubricating properties of molybdenum disulphide. Anon. *Sci. Lubric.*, 1955, **7** (6), 34–5.—The increasing use of molybdenum disulphide as a dry lubricant in cases where liq lubrication is difficult or impossible is remarked, and details are presented of bonding methods, effect of moisture, different methods of application, and contaminants on lubricating properties. "Lube-Lok," a solid film lubricant, consisting of graphite and molybdenum disulphide in a thermo-setting resin binder, is described in some detail, with particulars of specific applications. J. G. H.

475. U.S. research into lubricants for high temperatures. Anon. *Sci. Lubric.*, 1955, **7** (9), 32.—Research at SW. Research Institute, San Antonio, Texas, on high temp lubricants for high-speed aircraft and related equipment is briefly reported. Approaching the problem from the angle of aromatic phosphate esters and screening a large number of cpds, the most promising class was found to be the amyl phosphate esters, and details are presented of methods of varying physical properties by the incorporation of the tri-fluoromethylphenol group. J. G. H.

476. Lubrication of spinning rollers. Anon. *Sci. Lubric.*, 1955, **7** (11), 12–14.—Difficulties encountered in the effective lubrication of loose boss top rollers used in spinning machinery include leakage of free oil on to the leather or synthetic covers of the bosses, and under-lubrication of the arbors, resulting in irregular rotation of the bosses. These may be largely over-

come by the use of sintered metal bearings comprising a strong porous bronze or iron impregnated with lub oil, the oil being retained by the capillary attraction of the porous structure of the bearing. Such a system is claimed to reduce oil consumption by as much as 95% and to considerably extend periods between servicing. J. G. H.

477. Oil film extent in complete journal bearings. J. A. Cole and C. J. Hughes. *Sci. Lubric.*, 1955, **7** (6), 16–22.—The load-carrying film for a complete journal is known to extend over only part of the circumference, the remaining section being normally assumed to consist of cavitated oil. Investigations at M.E.R.L. on this problem have made use of glass bearings with an oil film made fluorescent by u.v. irradiation. A light mineral oil was used with speeds up to 5000 rev/min and loads up to 200 p.s.i. of bearing projected area, under a variety of conditions, the results being recorded photographically. These indicate that the full width film begins and finishes somewhat later than is assumed in conventional theory and that, under conditions of high speed and low load, the film is practically complete. J. G. H.

478. Lubrication tests with oil-soluble molybdenum complexes. M. G. Hugel. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1280–3.—Mo decylxanthate dissolved in SAE 30 (50 cp/50° C) oil, was tested in 4-ball machine. If load is applied suddenly seizure occurs more rapidly than formation of protective film. If load is successively increased, using same balls and oil, high pressures can be tolerated, as film has had time to build up. Some improvement in results, for sudden load application, are obtained if balls are pre-treated in oil containing 8% of Mo decylxanthate and then heated to 300°–320° C to decomp complex and leave sulphide film. V. B.

479. New synthetic grease is good performer. J. P. Dilworth and J. R. Roach. *Oil Gas J.*, 12.12.55, **54** (32), 103.—A mixed soap–solid thickened synthetic oil grease is described which lubricates bearings over the range −65° to 450° F. Low and high temp, and high speed performance is given and comparison made with existing MIL specification greases. G. A. C.

480. Synthetic lubricating oils. L. Tokarzewski. *Nafta (Krakow)*, 1954, **10**, 185–8, 213–15.—A brief sketch of the development of this industry, method of manufacture, and details of some of such lubricants of German origin based mainly on CIOS and BIOS reports. M. S.

481. Testing of lubricants for lubricity by means of the Wieland and 4-ball apparatus. II. M. Brunner and R. Pedrini. *Schweiz. Arch. angew. Wiss.*, 1955, **21**, 251–7 (cf. Abs. **1476**, 1955).—Improved load-carrying capacity of used oils, containing Pb decomp products from TEL, is confirmed by favourable effect of additions of colloidal graphite and MoS_2, but latter does not improve load-bearing of low lubricity silicone oils. V.I. improver (Acryloid 710) had no effect. Test results are also given with E.P. additives and synthetic (ester) lubricants, and on greases. Wieland tester gives valuable indications, corresponding with practice, regarding lubricating properties of these materials, although 4-ball tester is more suitable for E.P. oils. V. B.

482. Navy boosts "miracle" dry lube. Anon. *Nat. Petrol. News*, 1955, **47** (10), 109.—A new plastic product, known as "Teflon," having great possibilities but definite limitations, is hailed by the U.S. Navy as a miracle dry lubricant.

Tests have proved that Teflon will lubricate weapons for an almost indefinite period. It is already well established as a protective coating and electrical insulating material, and the lab believes it can be used as a dry lubricant for bearings, gears, screw threads, valves, and hydraulic and pneumatic equipment subject to friction and requiring a lifetime lubricant.

Teflon is applied by spraying a thin film on to the component, air drying, and baking at 725° C. Although unsuitable for metals or wood, which will not withstand the baking temp, it is otherwise serviceable from 75° below zero to 500° above. M. P. T.

483. Bearings, lubricants, and lubrication. A digest of 1954 literature. Anon. *Mech. Engng*, 1955, **77** (9), 789.—Subjects covered include: automotive lubricants, gear lubrication, metalworking lubrication, and properties of lubricants. 230 refs. T. T.

SPECIAL HYDROCARBON PRODUCTS

484. Insulating oils. Various. *Bull. Soc. franç. Electr.*, 1955, **5**, 768–89.—Report of discussion on papers covered by Abs. **259, 260, 262, 496, 498, 499, 501, 502** of 1955; together with certain additional findings and comments of the various authors concerned. V. B.

485. Wax—the most versatile product of the oil industry. C. F. McCue and S. Curds. *Inst. Petrol. Rev.*, 1955, **9** (101), 97.—Wax is of 2 main types—paraffin wax and microcrystalline wax. Paraffin wax is obtained from crude oil in 3 stages: concn into one fraction by dist; precipitation by chilling, and filtration; and "sweating" to reduce the oil content. Microcrystalline wax is obtained from the dist residues of crude oils by selective solvent treatment, subsequent filtration and centrifuge, and finally by adsorbent percolation. The 2 types of wax have different properties, the former being a mixture of C_{20}–C_{30} straight-chain paraffins, with a m.p. of 90°–150° F, while the latter comprises a mixture of C_{30}–C_{50} straight and branched-chain hydrocarbons, of higher m.p. Marketing details are considered, and the application of waxes is discussed relative to the important properties. These are: (1) inflammability leading to use in candles, tapers, matches, etc; (2) impermeability—paper, board, and canvas waxing; coating of fruit and cheese; lining of cans and barrels; (3) thermoplasticity—modelling of different kinds, poultry defeathering; (4) gloss—polishing; (5) electrical insulation—cables and radio components, etc; (6) miscellaneous. Thus wax, like bitumen, has a multiplicity of uses in all walks of life. R. H.

DERIVED CHEMICAL PRODUCTS

486. Petroleum-chemical developments in the U.S.A. C. F. M. Mackintosh and H. Steiner. *Petrol. Times*, 9.12.55, **59** (1522), 1271.—A survey is given of recent developments in the U.S. petroleum-chemicals industry. Products dealt with include ethylene and its derivatives, polyethylene, plastics, synthetic rubbers, fibres, detergents, and nitro-paraffins. G. A. C.

487. Petroleum-chemical developments in Japan. C. F. M. Mackintosh and H. Steiner. *Petrol. Times*, 25.11.55, **59** (1521), 1189.—A survey is given of the petroleum-chemical industry in Japan, and shows the great contribution which foreign participation, particularly American, has made in its revival. G. A. C.

488. Ammonia from Catformer tail gas. J. H. Arnold and W. T. Dixon. *Oil Gas J.*, 28.11.55, **54** (30), 90.—Results are given of 18 months experience of operation of a 100-ton/day anhydrous ammonia plant using hydrogen from Catformer tail gas at Atlantic Refinery Co's Philadelphia refinery. G. A. C.

MISCELLANEOUS PRODUCTS

489. Butyl rubber. M. Moulin. *Bull. Ass. franç. Tech. Pétrole*, 1955, 569–99.—Material (GR-1) made by copolymerization of *iso*butylene and 1½–3% isoprene at −95° C, using $AlCl_3$ cat and CH_3Cl as diluent. Mol. wt. has so far been 315,000–505,000, but product with mol. wt. 10^6 is now on the market. Characteristics of main U.S. grades are tabulated, and manufacture, properties, and processing for various

purposes are described. Blending characteristics of butyl rubber with carbon black and with other elastomers are discussed. U.S. consumption for 1954, 62,000 tons; fall from 1953 value of 77,000 is largely due to introduction of tubeless tyres, but versatility of butyl rubber indicates steadily expanding requirement therefor. French production plans are for 20,000 tons/year. V. B.

490. Fluid coke—new fuel for steam industry. F. H. Stracke and F. H. Schiffer. *Oil Gas J.*, 28.11.55, **54** (30), 75.—Lab and plant-scale tests show that in the steam raising industry fluid coke can compete with coal, gas, and oil. Results of full-scale combusion tests at Essen station of Public Service Electric and Gas Co, Newark, N.J., are given. G. A. C.

CORROSION

491. The prevention of corrosion. Anon. *Trans. Inst. Mar. Engrs*, 1955, **67** (4), 132.—The lessons to be drawn from 25 years of research by the Corrosion Committee of the British Iron and Steel Research Association are discussed. 15 refs. T. T.

492. Reports to Technical Unit Committee T-IJ on oilfield structural plastics. Pt 1. Long term strengths of reinforced plastics determined by creep strengths. H. D. Boggs. *Corrosion*, 1955, **11** (11), 57–9.—It was found that the resins used are the central factor in the long term strength of the product. Bond failure, elongation failure, and low tensile strength failure were also briefly discussed. W. G. R.

493. Reports to Technical Unit Committee T-IJ on oilfield structural plastics. Pt 2. Microscopic examination as a test method for reinforced plastic pipe. C. de Ganahl. *Corrosion*, 1955, **11** (11), 59–60.—Microscopic equipment having a magnification of 20–120× is suitable for distinguishing lack of ashesion in resin to glass from fracturing of resin where adhesion is still satisfactory. Reflected light when shown at 30°–40° to the surface of the sample and at right angles to the direction of glass fibres is useful in tests. W. G. R.

494. Electrochemical studies of the hydrogen sulphide corrosion mechanism. S. P. Ewing. *Corrosion*, 1955, **11** (11), 497–501t.—Experimental evidence shows that the anodic and cathodic reactions in the H_2S corrosion process are the important ones. The corrosion process is explained further in terms of the electrochemical properties of the corroding soln and the corrosion products. The possible usefulness of an understanding of the corrosion process is demonstrated by a few practical applications. W. G. R.

495. Current status of corrosion mitigation knowledge on sweet oil wells. Technical Unit Committee T-1C. *Corrosion*, 1955, **11** (10), 61.—This report summarizes the problems involved and discusses some theoretical aspects and practical mitigation measures. W. G. R.

496. Basic essentials for the reduction of atmospheric corrosion. F. Radecke. *Corrosion*, 1955, **11** (10), 437–41t.—A 4-phase plan used by a refinery to reduce atmospheric corrosion through the improvement of exterior coating protection is described. Included is a discussion of factors to be considered in setting up a maintenance painting programme. A plant specification standard prepared by an oil company is also given. W. G. R.

497. Microbiological corrosion of iron and steel. D. M. Updegraff. *Corrosion*, 1955, **11** (10), 442–6t.—A critical review of the literature, a brief account of the history, a discussion of the mechanisms by which micro-organisms affect corrosion, and methods of alleviating microbiological corrosion are incorporated. Specific mention is made of oil well corrosion. W. G. R.

498. Air injection for prevention of hydrogen penetration of steel. W. A. Bonner and H. D. Burnham. *Corrosion*, 1955, **11** (10), 447–53t.—The use of very small amounts of air for the prevention of hydrogen attack leading to blistering and fissuring of equipment is described. The protection is achieved by producing a small amount of polysulphide *in situ* which converts cyanide to thiocyanate and inhibits the primary corrosion reaction. The solutions of a number of problems encountered in the application of the method are also included. W. G. R.

499. This zinc coating can be applied in the field. D. H. Stormont. *Oil Gas J.*, 5.12.55, **54** (31), 114.—A zinc coating which was developed in Australia which can be sprayed or brushed on as a "cold-galvanized" process is described. It is a promising agent against corrosion for a variety of oilfield and refinery installations, such as floating roof decks, wellheads, caissons, and salt-air applications. G. A. C.

500. Here's Pure's new corrosion meter. G. A. Marsh and E. Schasche. *Oil Gas J.*, 21.11.55, **54** (29), 135.—A new corrosion meter has been developed by Pure Oil Co, Crystal Lake, Illinois. It is a simple temp-compensated device which makes use of the change of electrical resistance during corrosion to determine loss in metal thickness.

The second part of the article describes how to use the meter to measure tanker corrosion rates. G. A. C.

501. Surface pipe effect—cathodic protection of oil well casing. J. P. Barrett. *Corrosion*, 1955, **11** (10), 415–6t.—The potential profile curve obtained on a well under cathodic protection will often show an abrupt anodic slope at the base of the surface pipe. Considering the case of a W. Texas well, it is concluded that this surface pipe effect is caused by the 2 strings of casing being in contact with one another at the bottom of the surface string or at points above this level. W. G. R.

502. Corrosion control on offshore drilling and producing equipment. C. J. Fritts. *Corrosion*, 1955, **11** (11), 471–6t.—Protection of submerged areas of offshore stationary drilling platforms by cathodic protection is recommended. It is also recommended that horizontal and diagonal bracing be above or below the splash zone, *i.e.* from the water level to 10 ft above. For protection in this zone, a choice of Gunite, Monel, porcelain enamel, sheet Neoprene, flame-sprayed polythene, plastic tapes over vinyl, metallizing, and vinyl mastic systems is given. The recommendation for the atmospheric zone is a 6-coat min, 6-mil vinyl system. W. G. R.

503. Some economic data on chemical treatment of gulf coast cooling waters. NACE Task Group T-SC-1. *Corrosion*, 1955, **11** (11), 61–3.—Inhibitors are used in cooling water to regulate pH, reduce scale and corrosion, and control algæ. Materials used include H_2SO_4, caustic, sulphur, gluersates, sodium polyphosphate, sodium dichromate, chlorine, and commercial products. Costs of treating circulating water are given. W. G. R.

504. A note on the value of ammonia treatment for tank and casing annulus corrosion by hydrogen sulphide. W. F. Rogers. *Corrosion*, 1955, **11** (11), 488–90t.—4-year tests indicate that ammonia injections are beneficial in protecting the steel previously unexposed to sour crude for *ca* 4–8 months. After this time, or if the steel has already been exposed to hydrogen sulphide, the ammonia has little or no effect. W. G. R.

505. Use of ammonia to prevent casing corrosion. H. E. Greenwell, R. Loncaric, and H. G. Byars. *Corrosion*, 1955, **11** (11), 491–6t.—The theoretical behaviour of ammonia used

as an inhibitor in the liq phase of oil wells is surveyed. Lab experiments show that if the ammonia were injected too fast solid ammonium bicarbonate and carbonate would be formed.

Authors say the experiments proved conclusively ammonia will penetrate below the zones of most corrosion, that the rate of ammonia consumption is low, and that the reactions occurring should stifle corrosion. W. G. R.

506. Compressor station equipment corrosion problems and remedies. J. C. Berringer. *Pipe Line News*, 1955, **27** (10), 55–9.—Corrosion problems often met with on compressor stations are due to cooling water, cavitation and impingement of pistons of aux pumping equipment due to rapid pressure fluctuations in the cyl, corrosion of after cooling coils, water tanks, and special problems due to hydrogen sulphide in the pumped gas. The majority of these problems can be solved by the correct use of cathodic protection methods. B. A. F.

507. The effect of martensite on sulphide stress corrosion cracking. M. F. Baldy and R. C. Bowden, Jr. *Corrosion*, 1955, **11** (10), 417–22t.—Rapid failures of tubing in sour condensate wells led to an investigation. Test bars, heat-treated to produce martensite contents varying from 0 to 100%, were 2-point beam loaded and immersed in a bath of dist water saturated with hydrogen sulphide and carbon dioxide. All samples were loaded to various stress levels below the yield strength of the material (API Grade N-80).

It was found that when martensite begins to show evidence of continuity in the microstructure, the steel becomes susceptible to sulphide stress corrosion cracking. W. G. R.

ENGINES AND AUTOMOTIVE EQUIPMENT

508. Crankcase explosions in marine engines. J. H. Burgoyne and D. M. Newitt. *Trans. Inst. Mar. Engrs*, 1955, **67** (8), 255.—The British Shipbuilding Research Committee put in hand a comprehensive investigation in 1948, and some aspects are still being pursued. The available evidence suggests that the explosive medium is normally formed from lub oil and air. A suspension of liq droplets may form either by mechanical dispersion of the oil as spray or by condensation after volatilization due to contact with a relatively hot engine component. 5 refs. T. T.

SAFETY PRECAUTIONS

509. When is an area hazardous? L. M. Goldsmith. *Oil Gas J.*, 21.11.55, **54** (29), 152.—Hazardous areas are defined in relation to installation of electrical equipment and explosion proof fittings. API RP-500 publication on recommended practice for such areas is discussed. G. A. C.

510. Los Angeles refiners move in on smog. D. H. Stormont. *Oil Gas J.*, 14.11.55, **54** (28), 160.—An outline is given of steps taken and technical details of the procedures adopted to attack the smog problem in Los Angeles. Control of hydrocarbon evaporation, curbing of smoke and dust, and recovery of sulphur opds from waste gases are 3 lines of attack. The programme has halved the sources of pollution and has cost $25,000,000 for control equipment and an additional $2,500,000 for research. G. A. C.

MISCELLANEOUS

511. Markets strong as fall season ends. F. Holman. *Nat. Petrol. News*, 1955, **47** (12), 138–53.—The article reviews current U.S. price trends in crude oil and petroleum products. Tanker freight rates are blamed for an overall increase in prices.

There are numerous tables giving statistical details of U.S. markets. 4 graphs. M. P. T.

512. Hastening atomic power. Anon. *Petrol. Press Serv.*, 1955, **22**, 430–4.—The coming year will see the world's first full-size atomic power station in operation in the U.K. More will be completed in Europe and America before the end of the decade, and by the end of the next, tens of millions of kW of electricity will be available from nuclear sources. Yet atom power cannot quickly transform the energy scene, nor will it for many years to come exert any check upon the further rise of the world's oil needs. But the oil industry may hope greatly to benefit from the continued development of atomic science and technology, especially from new potentialities of radiation chemistry, which could lead to revolutionary innovations in refining techniques and to the development of still better petroleum products. 1 fig. (Author's abstract.)

513. National fuel resources in the light of national fuel requirements. G. E. Foxwell. *J. Inst. Fuel*, Nov. 1955, **28** (178), 551.—An assessment is made of the national energy requirements for the next 25 years, fuel required for road and air transport being excluded. Energy resources available are reviewed and costs, etc., discussed. Estimates for U.K. fuel position in 1975 and 1980 are given as millions of equivalent tons of coal. In 1975 oil fuel may supply 40 millions of equivalent tons of coal, atomic power 30, and coal 250. In 1980 it may be oil fuel 50, atomic power 40, and coal 250. 26 literature refs. D. K.

514. Petroleum and natural gas research. Anon. *Petrol. Times*, 23.12.55, **59** (1523), 1317.—A survey is given of the work during 1953 of the Petroleum Division of the U.S. Bureau of Mines.

Subjects studied include flow of natural gas in pipelines, gas injection, composition and stability of diesel fuels, low temp calorimetry for entropy data, and thermodynamic properties of pure hydrocarbons. G. A. C.

515. Polish Petroleum Institute during the 10 years of democratic Poland. J. Wojnar. *Nafta (Krakow)*, 1954, **10**, 163–7.—A brief history of the Institute from 29 Nov. 1944, its activities, development, and progress in the field of scientific work. Shortly after the start the Production Dept established statistical records, Chemical Dept carried out several analyses of brines, and Educational Dept started technical schools. Publication of *Nafta* was started in June 1945. During 1947–51 the Institute moved to own premises in Krakow, Krosno, and Trzebinia. Several problems were tackled and solved in conjunction with Dept of Physics of the Krakow Academy of Mining and Smelting. M. S.

516. Training of petroleum personnel in 1945–54. J. Czastka. *Nafta (Krakow)*, 1954, **10**, 167–70.—A summary of secondary and technical teaching. Number of schools rose from 3 to 8 and students from 113 to 1005. Short courses were attended by 1771 men. The Krakow Academy of Mining and Smelting has 5-year courses in drilling and production. During 1945–54 121 men graduated. M. S.

517. Papers at the Joint Conference on Combustion. Anon. *Petrol. Times*, 23.12.55, **59** (1523), 1330.—Papers are sum-

marized given (Sections III, IV, and V) at the joint conference IME and ASME held on combustion in London, Oct. 1955. G. A. C.

518. World's biggest refinery comes back. P. Swain. *Oil Gas J.*, 28.11.55, **54** (30), 71.—This is the third in a series of articles outlining the operation of Iran's oil industry since it was taken over last year by the consortium. Overhaul work on the units is described. Throughput has now reached 148,000 b.d. during first year (rated capacity is 500,000 b.d.). G. A. C.

519. The answer is the crude oil man. H. D. Ralph. *Oil Gas J.*, 14.11.55, **54** (28), 180.—A survey is presented of the crude oil purchasing operation, and the place occupied in the operation by the crude oil man. Gathering, transportation, and delivery of oil to refineries is shown to be an orderly process. A glossary of terms used is given. G. A. C.

520. The outlook for U.K. energy needs. C. P. Dalton. *Inst. Petrol. Rev.*, 1955, **9** (101), 109.—In the present day competitive industrial world, the U.K. must have an adequate supply of energy. This has in the past been supplied almost exclusively from coal, but the changing situation in the coal mining industry has made it imperative to look for other sources. The contribution of oil has risen from 6 to 13% of the total energy from 1930 to 1953. Since industrial production continues to increase, even greater supplies of energy will be required, and much of this increase will come from oil, since the coal industry is not increasing production sufficiently rapidly, and atomic energy will not make its presence felt to a significant extent for a number of years. R. H.

521. In pursuit of stability. Anon. *Petrol. Press Serv.*, 1955, **22**, 425–7.—While changes in basic prices and in the relationships between the several petroleum products must inevitably occur from time to time, various natural features, also organizational factors within the oil industry, which are discussed in this article, bring about a remarkable degree of stability in the basic prices for petroleum products, and even more in those for crude oil, which contrasts with the price instability of many other commodities in international trade. 1 fig. (Author's abstract.)

522. Chimneys and the dispersal of smoke. J. E. Hawkins and G. Nonhebel. *J. Inst. Fuel*, Nov. 1955, **28** (178), 530.—To prevent smoke being blown rapidly to the ground minimum chimney heights and exit velocities of flue gases are necessary; these are related to height of surrounding buildings, local contours, and dia of chimney. Even when smoke avoids buildings, etc., part of it reaches the ground at distances beyond 6 times the effective height of the stack. The effective height of a chimney is discussed. Theoretical formulæ for calculation of smoke concn at any distance from the chimney and rate of dust and grit deposition are discussed. In an appendix meteorological considerations are discussed. There are 24 literature refs. D. K.

BOOK REVIEWS

The Chemistry of Petroleum Hydrocarbons. Vol. II and III. Ed. B. T. Brooks, C. E. Boord, S. S. Kurtz, and L. Schmerling. New York: Reinhold Publishing Corpn, 1955. Pp. vi + 448; vii + 690.

The first volume in this work recently reviewed in this *Journal* (Nov. 1955) was primarily concerned with the composition of petroleum, the physical properties of hydrocarbons, particularly those of value in determining composition and structure, physical methods of separation, and the synthesis of hydrocarbons of various types. The present volumes deal with the reactions of hydrocarbons; Volume II, with those involved in conversion processes and hydrocarbon oxidation, and Volume III with reactions of olefins and the substitution reactions of paraffins, naphthenes, and aromatic hydrocarbons.

Conversion processes are those employed to convert hydrocarbons from one type to another and thus include the all-important thermal decomposition processes of cracking and pyrolysis, catalytic dehydrogenation, cyclization and aromatization, isomerization, and destructive hydrogenation. (Hydrogenation of olefins has been separated as a reaction of olefins and discussed with other olefin reactions in Volume III.) The chemistry of all these processes has been fully dealt with in a number of chapters by well-known authorities in the fields in question. Practically all of the reactions involved can be satisfactorily explained on the assumption that either carbonium ions or free radicals are involved. Accepting this hypothesis it became possible to put forward a theory which provides a rational explanation of all the complex reactions involved in cracking processes and for the products formed. Thus the essential differences between thermal and catalytic cracking are readily understandable on the basis of the former involving a free radical mechanism and the latter an ionic.

Hydrocarbon oxidation is dealt with in a number of chapters both from the point of view of olefin autoxidation responsible for storage instability and gum formation and also from that of chemical production. There are, however, several noteworthy gaps, in particular with regard to the oxidation of *cyclo*paraffins and aromatic hydrocarbons (other than *o*-xylene).

Olefin reactions and, in particular, those of interest to the petroleum industry, *e.g.* hydrogenation, polymerization, isomerization, alkylation, and formylation (the Oxo process) are to be found in Volume III. It is unfortunate that the account of Ziegler's work in the field of ethylene polymerization, as well as that of the Phillips Petroleum Co, was published too late to be included in the chapter on polythene which is consequently somewhat out-of-date.

Aromatic substitution is discussed in the last four chapters of Volume III. Considerable space—over 100 pages—has been devoted to the theory of mechanism of aromatic substitution which is treated far more fully than appears justified outside a treatise on organic chemistry.

The absence of any detailed outline of the work as a whole renders it difficult at times to judge whether apparent omissions are intentional or not. There are no indications that Volume III is to be the last, although from the wide range of subjects covered to date it would seem difficult to find material to fill a fourth volume.

The two present volumes are well up to the standard of the first and provide a valuable addition to the literature of the chemistry of petroleum hydrocarbons. Again the editors are to be congratulated on their work, their selection of contributors, and on the excellence of the production as a whole. S. F. B.

The Chemistry of Petrochemical Reactions. L. F. Hatch. Houston, Texas: Gulf Publishing Company, 1955. Pp. vii + 182. $4.50.

This book consists of edited reprints of a series of 17 articles which appeared in the *Petroleum Refiner* during 1953 and 1954. The main purpose of these articles was to describe those basic reactions of petroleum hydrocarbons used for the manufacture of petroleum chemicals. References are made to the processes based on these reactions and flow sheets are provided in many cases, but the emphasis is on the chemistry and the mechanism of the reaction. The book also deals, to a minor extent only, with the applications of the products from these chemical reactions and does not delve further into the further conversion of

petroleum chemicals into plastics and rubbers, apart from dealing with polymerization as a reaction.

With this restricted content in mind, it should be stated that the book provides an admirably clear and concise guide to the nature and mechanism of the reactions involved, its readability being enlivened by occasional flashes of humour. It can scarcely be considered in relation to previous books on chemicals in petroleum, *e.g.* Carleton Ellis and Goldstein, owing to its limited bulk and restricted field. In this connexion your reviewer wonders why the size of books on chemicals from petroleum is apparently in indirect relation to the rapidly growing market. If this trend of thought is pursued graphically, it can be shown that the next book on petroleum chemicals is due to appear in 1958 and to contain one hundred pages. We trust this is not the case.

The book opens with a general outline of the chemical composition of crude oil and a brief indication of the basic reactions of each type of hydrocarbon. Chapters are then devoted to the non-hydrocarbon constituents, *i.e.* sulphur, nitrogen, and oxygen compounds. Then follow chapters dealing with oxidation, chlorination, nitration, and sulphation of paraffins and aromatics, the remainder of the book covering all types of reactions of olefins, diolefins and acetylenes, with a final chapter on chemical reactions involving air and methane.

As a book for reference and general guidance on reactions used in the manufacture of chemicals from petroleum, it is to be recommended. A minor handicap is that it can only be obtained by application to the publishers in the U.S.A.

C. L. G.

ADDITIONS TO THE LIBRARY

Reactions of Carbon with Carbon Dioxide and with Steam. C. G. von Fredersdorff. Institute of Gas Technology Research Bulletin 19. Chicago, Ill: The Institute, 1955. Pp. 75. $7.50.

This study of the high temperature reactions in the range 1700°–2000° F between a solid fuel and oxidizing gases is discussed from the point of view of: (*a*) the development of mathematical procedures, and (*b*) the application of these procedures to the interpretation of steam and carbon dioxide decomposition rates and gas analyses.

Most of the experimental data were obtained with continuous flow fixed-bed reactors operating at atmospheric and superatmospheric pressures in the Institute's laboratories in Chicago. Results reported by others are analysed in a literature study and addendum.

Bollettino Statistico. Unione Petrolifera, Rome, 1955. Pp. 43.

Detailed statistics of the Italian petroleum industry during the first six months of 1955.

World Oilmen. London: Sylvan Press, 1955. Pp. 100. £2 2*s*.

A collection of pictures illustrating all phases of work and operations in the petroleum industry.

Determination of Shear Stability of Non-Newtonian Liquids. N. D. Lawson. ASTM Special Technical Publication. Philadelphia, ASTM, 1955. Pp. 12. 75 cents.

This publication will be of value to those concerned with development or use of polymer liquids and of mechanical devices in which those liquids are used. It describes several test procedures which are capable of giving comparable results including sonic vibrators, sharp-edged orifices, flow through a diesel fuel injector, and a pressure release valve. The two test liquids were made by blending polyalkyl methacrylate polymers with a light petroleum base oil.

Report of the Work of the XVIIIth Congress. Permanent International Association of Navigation Congresses. Rome, 1953.

1955 Book of ASTM Standards (including Tentatives). Pt. 3. Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing, Soils. Philadelphia: American Society for Testing Materials, 1955.

ASTM Standards on Plastics. Philadelphia: American Society for Testing Materials, 1955.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

523. The geologic framework of the Wilcox reservoir. L. J. Ryman. *Oil Gas J.*, 7.11.55, **54** (27), 164.—The stratigraphy and structure of the Wilcox reservoir in Texas are described. The producing area of the formation is 40–60 miles wide, paralleling the coast 40–150 miles inland.

There is consistent down-dip thickening; at surface it ranges from 500 to 1200 ft thick, increasing to 6500 ft subsurface. Dip towards the coast averages 150 ft/mile, and almost every structure along the trend is associated with faulting. There are many traps where Wilcox sands separated by shales are coincident with fault zone structures.

285 fields in Texas produce oil or gas from the formation; 8·1% from simple anticlines, 59·0% from faulted anticlines, 7·7% from stratigraphic traps, 15·8% from fault closures, and 2·4% from salt domes.

Reservoir characteristics and lithology vary regionally, and permeability and porosity tend to decrease with depth, with commercial production below 9500 ft being uncommon.

C. A. F.

524. Horseshoe atoll back in the news. C. Hoot. *Oil Gas J.*, 12.12.55, **54** (32), 160.—The development of reef fields in the Horseshoe atoll in the Midland basin of W. Texas is outlined briefly. The latest discovery is a Pennsylvanian reef in Hockley County at *ca* 9600 ft. The most important fields are in Scurry County, and drilling has shown that the reef banks are discontinuous and of variable extent and build-up. Water levels vary from one " high " to the next and within the same structure.

C. A. F.

525. Good Omen field emphasizes need for stratigraphic study. J. P. O'Connor. *Oil Gas J.*, 12.12.55, **54** (32), 154.—The geology and the reservoir characteristics of the Good Omen field in Smith County, Texas, are described. The field is on

the W. flank of the Sabine Uplift, W. of the E. Texas field, and production is from the top sand of the Woodbine, which is replaced up-dip by impermeable sandy shale. The structure is a local W.-plunging nose.

The reservoir originally included *ca* 300 acres, and 13 producers have been completed at *ca* 4000 ft. Average net pay thickness is 10 ft, and porosities average 25%. Oil gravity is 42·0° API and connate water 33%. C. A. F.

526. South Texas' thriving Olmos trend. J. E. Glover. *Oil Gas J.*, 19.12.55, **54** (33), 129.—The stratigraphy and oilfields of the Olmos formation in S. Texas are described; the Olmos is part of the Navarro group, consisting of thin sands interbedded with massive shales. Oil is produced mainly from the 2 top sands (A and B). Fields occur along up-dip pinch-outs to the E., and some fields have been found along a fault in the Pruitt area.

Exploration in recent years has been stimulated by the successful use of fracturing in stratigraphic traps, and further fields are being sought along the up-dip pinch-outs.

Maps and sections demonstrate the geological characteristics of the Olmos formation. C. A. F.

527. Tapping the Austin Chalk's rich reserves. W. M. Doyle. *Oil Gas J.*, 5.12.55, **54** (31), 180.—The Austin Chalk of S. Texas is a dense chalky limestone with very low primary porosity, and where the formation is productive secondary porosity occurs in the form of joints and fractures. Fracture porosity is developed in 2 general areas: the Pearsall anticline, which trends NE.–SW. across Frio County, and the Luling–Mexia fault zone.

In the area of the Pearsall anticline the Chalk averages 385 ft thick, comprising 82% $CaCO_3$ and 11% silica and silicates. Primary porosity is 6–8% and permeability 0·0–0·4 mD. Fracture porosity occurs as hairline breaks, mainly vertical, trending *en echelon* parallel to the fold axis; oil accumulations, controlled by the fracturing, have a complex distribution over the structure.

In the Luling–Mexia fault zone accumulations are in structural closures against the upthrown side of normal faults. The chalk is 120–350 ft thick, with 4–25% porosity and permeability 0·0–0·5 mD. Fracturing is associated with the faulting, and wells are productive only where they penetrate the shatter zones near the faults.

Past development indicates that the Austin Chalk has a very high reserve of oil, still largely undeveloped. C. A. F.

528. Cambrian pools are many-splendored things. F. J. Gardner. *Oil Gas J.*, 28.11.55, **54** (30), 147.—The Cambrian was found to be productive in W. Central Texas 2½ years ago, and there are now *ca* 100 producers along a 45-mile trend in 6 fields in Coke and Nolan Counties; largest field is White Flat.

The fields are difficult to find because the Cambrian structure is masked by pre-Pennsylvanian unconformities; structural relief decreases upwards, and a typical Cambrian structure of 150–1000 ft of closure may show only 30 ft in the Permian.

Best exploratory tools are concentrated seismic shooting or core drilling to shallow Permian markers. Cambrian pays range from 5300 to 6000 ft in depth. C. A. F.

529. Condemned prospects challenge geologists. O. C. Brown. *Oil Gas J.*, 21.11.55, **54** (29), 309.—In recent years S. Louisiana has been one of the most attractive areas for exploration in the U.S.A., and a number of fields have been discovered by subsurface geology. 3 of these fields are briefly described: Live Oak, Franklin, and Turtle Bayou and Kent Bayou. These are all within the Miocene trend, and can be mapped on one horizon. C. A. F.

530. Deepest producer. Anon. *Oil Gas J.*, 21.11.55, **54** (29), 130.—A gas condensate well in Weeks Island field, Iberia Parish, Louisiana, is producing 30 ft below the previous record. On test the well flowed 77 b.d. of 40·5° condensate and 2,901,000 cu. ft. gas/day from 17,558–17,584 ft. The well is a step out on the N. flank of the Weeks Island salt dome. C. A. F.

531. New Sooner trend stretches 30 miles. J. C. McCaslin. *Oil Gas J.*, 19.12.55, **54** (33), 127.—The recent discoveries in N. Oklahoma in the Grant West to Woods County area are outlined. Of main interest is a basal Pennsylvanian sand oil and gas-dist pay, which extends along an E.–W. trend for 21 miles. One of the discoveries, 1 Burghardt, found the first basal Pennsylvanian oil production W. of the Nehama Granite Ridge in N. Oklahoma.

Pay sand in the area ranges from 10 to 30 ft thick, with good porosity and permeability; average depth is 4900 ft. C. A. F.

532. Records fall at top and bottom of the U.S. map. F. J. Gardner. *Oil Gas J.*, 5.12.55, **54** (31), 179.—1-X Joes Valley in San Pete County, Utah, on test flowed 15,000 M.c.f. from Ferron-Cretaceous sand at 7090 ft; this will be the world's highest producer at an elevation of 9725 ft.

1-LL and E. Humble "L," 35 miles SE. of New Orleans, Louisiana, have been drilled to 22,250 ft, and at least 4 possible oil sands have been reported below 20,000 ft. This is the world's deepest well. C. A. F.

533. Williston—white elephant or white hope? F. J. Gardner and N. S. Morrisey. *Oil Gas J.*, 12.12.55, **54** (32), 98.—The main fields of the Williston basin in the U.S.A. have been found on the W. side along the trends of regional uplifts which can be contoured on surface and subsurface beds. Most of the discoveries have been deep, and little exploration has been carried out on the E. side, where favourable beds are shallower, but where there is a mantle of glacial drift obscuring surface structure. The main targets in this area are the Madison, Red River–Ordovician, and Winnipeg–Ordovician. There are prospects of multiple pays with shallow production. A map of the oilfields of the Williston basin is included. C. A. F.

534. What are prospects in Williston basin's east side? C. B. Folsom and S. B. Anderson. *Oil Gas J.*, 12.12.55, **54** (32), 92.—There are many possibilities of stratigraphic traps on the E. side of the Williston basin, where surface geology is obscured by glacial drift up to 300 ft in thickness. Fields discovered are in the N. of the area in Renville and Bottineau Counties, where production is from the Mississippian Charles and Canyon.

The stratigraphy and structure of the area are briefly described; favourable "pinch outs" include Mississippian Lodgepole and Devonian and Silurian formations uncomformably overlain by Trias and Jurassic.

Although few structures have been found, shallow depths and low well costs should encourage further exploration of the area. C. A. F.

535. Canada's Savanna Creek field climbs mountain. Anon. *Oil Gas J.*, 5.12.55, **54** (31), 81.—A third well is to be drilled on the Savanna Creek structure at an elevation of 8000 ft on Plateau Mountain 60 miles SW. of Calgary, Alberta. 2 wells on the structure, which is within the Rocky Mountains, showed a closure of over 1500 ft and a producing formation over 600 ft thick; on test gas has been produced from 5 zones between 7700 and 8301 ft in the Mississippian Rundle. C. A. F.

536. Dolomite production found on north coast—Jones strike perks up Cuban hopes. H. Wassall. *Oil Gas J.*, 26.12.55, **54** (34), 139.—A well 12 miles E. of Havana at Santa Maria del Mar (2 Thomas Bess) has been completed for over 125 b.d. of 16·5° oil from dolomite overlying serpentine. It is about one mile N. of the old Bacuranao field in an area where there has been recent drilling activity.

The well is located on the N. flank of the Havana–Matanzas anticline, which is a fold of Tertiary rocks overlying very contorted Upper Cretaceous clastics and volcanics with dips ranging from 20° to vertical. C. A. F.

537. Nigerian search mocks oil explorers. Anon. *Oil Gas J.*, 2.1.56, **54** (35), 66.—Although bitumen seeps have been known in Nigeria for many years, commercial production has not been found. Several tests have been drilled in S. Nigeria following

geological exploration of the sedimentary area around the Niger delta, and 6 wells drilled from 1951 have had shows of oil or gas; 5 of these are E. of the Niger, and the latest test at Elkin had better indications than earlier wells. C. A. F.

538. Oil exploration in Papua. L. A. Pym. *Chem. Engng Min. Rev.*, 1955, **48**, 85–9.—The discovery in 1911 of gas and oil seepages in the vicinity of plantations in the Vailala River region aroused interest in the possibility of finding oil in commercial quantities in Papua.

Since then, much time and money have been spent on exploration activities, such as aerial photography and mapping, over almost the entire foothills country from Yule Island in the E. to the Dutch border of New Guinea in the W. In addition, geological reconnaissance, aerial magnetic surveys, ground geophysical reconnaissance, and drilling of test wells to a depth of more than 80,000 ft have been carried out over wide areas at a cost exceeding £A16,000,000.

The paper outlines present interests and future plans. 5 figs. M. P. T.

539. West German oil continues its expansion. A. M. Stahmer. *Oil Gas J.*, 26.12.55, **54** (34), 210.—Oil exploration and development in W. Germany in 1955 is described. 10 new fields were found in the first 10 months of the year as a result of intensive seismic work and drilling. In Emsland an oilfield has been found *ca* 2 miles NE. of the Ruehlermoor field in the Bentheim sand, and gas has been found at Adorf in Zechstein dolomite. In the Weser–Ems area oil has been found in the Kimmeridge at Vestrup, and a well at Wietingsmoor found Valendis oil as an extension of the Duesta field. In Hanover, Leuben 1 found oil in the Dogger beta, and a secondary recovery project has been started in the old Nienhagen field.

In the Upper Rhine Valley important pays have been found in Pechelbronn beds at Landau in a fault zone in the W. edge of the Upper Rhine Graben.

In S. Bavaria oil has been found at Heimertingen in the Baustein of the Suesswassermolasse, and gas at Steinkirchen and Gendorff. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

540. Can gravity surveys map subsurface structures? W. F. Stackler. *Oil Gas J.*, 14.11.55, **54** (28), 263.—Experimental results have shown that gravity surveys can map structure in the foothills and reef area of Alberta, provided that: (1) the profile is run at right angles to the structure; (2) the stations are *ca* 200 m apart; and (3) the stations are carefully repeated to give an accuracy of 0·01 mG.

Field results of gravity surveys over the Erskine (reef) and Turner Valley (faulted anticline) fields in Alberta are described. Cross-sections illustrate the interpretations. It is concluded that the gravity meter can obtain results under heterogeneous density distributions and difficult topographical conditions. C. A. F.

541. European Association of Exploration Geophysicists. L. H. Tarrant. *Nature, Lond.*, 1956, **177**, 120.—Summary of the 9th meeting, London, Dec. 1955. Among the topics discussed were: magnetic recording techniques, velocity logging of boreholes, a new airborne magnetometer, utilization of high frequency (70–200 cycles/sec) seismic system, and instrumental distortion. H. C. E.

DRILLING

542. Effect of mud column pressure on drilling rates. A. S. Murray and R. A. Cunningham. *J. Petrol. Tech.*, 1955, **7** (11), AIMME Tech. Paper No. 4166, 196–204.—Lab equipment is described in which the influence of hydrostatic pressure on drilling rate for a variety of rocks has been investigated. These included shales, limestone, dolomite, sandstone, and quartzite. In most cases there was a decrease in drilling rate with increase in hydrostatic pressure. The relative changes varied considerably, as did the pressure at which the minimum rate occurred. In 2 cases there was no marked change. Decreases of as much as 90% occurred. Field data from Leduc showed similar effects.

It appears that drilling costs might be appreciably reduced if means of reducing the pressure due to the mud column could be found. This is confirmed by the increased rates attained with air or gas as circulating fluid. Air–mud mixtures have also been suggested. There is some evidence that the effects noted may be less with permeable rocks, but even there filter cakes may in practice offset this feature. G. D. H.

543. Louisiana well hits record depth. E. McGhee. *Oil Gas J.*, 14.11.55, **54** (28), 130.—Drilling developments and problems of the record wildcat in the Mississippi delta 35 miles SE. of New Orleans are outlined; the well had exceeded 21,482 ft, the previous record, and it is planned to drill to at least 22,500 ft. Cores from below 20,000 ft had encouraging shows.

The mud is lime treated with 8% diesel oil weighing *ca* 18 lb/gal, fluid loss is 1–2 cc API. Static bottom hole temp is *ca* 350° F. C. A. F.

PRODUCTION

544. Porosity measurement by electrical methods. H. Cambefort. *Rev. Inst. franç. Pétrole*, 1955, **10** (10), 1205–8.—For a porous and permeable mass saturated with fluid of resistivity ρ_0 the resistivity is $\rho = F\rho_0$, where F is the formation factor. The latter has been related to the porosity, n, by $F = \frac{a}{n^b}$, a and b being constants, assigned the values 0·62 and 2·15, respectively. Rayleigh deduced a relationship

$$n = 1 - \frac{2}{3}\left(1 - \frac{\rho_0}{\rho}\right)\left[1 + \frac{2}{3}\left(1 - \frac{\rho_0}{\rho}\right) + \ldots\right]$$

for non-conducting particles dispersed in conducting liq.

Experimental data have been obtained using loose grains or gravel in a container 30 × 10 × 10 cm, and the results give a good linear plot on logarithmic paper, and this is represented by $\varepsilon = \frac{1{\cdot}56}{(\rho/\rho_0 - 1)^{0{\cdot}5}}$, where $\varepsilon = \frac{n}{1-n}$. This held for values of n up to 0·85. Rayleigh's formula, using 2 terms, agreed well for porosities over 0·3. The formula also agrees well with data obtained by Albert and Chaumet by a different approach. G. D. H.

545. Calculation of unsteady-state gas flow within a square drainage area. J. Douglas, D. W. Peaceman, and H. H. Rachford. *J. Petrol. Tech.*, 1955, **7** (11), AIMME Tech. Paper No. 4165, 190–5.—The alternating-direction method for the solution of 2-dimensional heat-flow problems by a numerical procedure has been adapted to the calculation of the depletion of a square region containing a perfect gas. Hitherto this problem had been solved numerically only for linear and radially symmetrical reservoirs. The calculations were made on an electronic computer, and the solutions are presented in graphical form. The results are compared with the radial solution, and for the pressures along the diagonals the deviation in pressure is less than 1% of the pressure decline. An approx method is suggested which require. the published radial solutions and a universal isopiestic map. G. D. H.

546. Studies on pressure distribution in bounded reservoirs at steady state. C. S. Matthews and H. C. Lefkovits. *J. Petrol. Tech.*, 1955, **7** (11), AIMME Tech. Paper No. 4164, 182–9.—Matthews, Brons, and Hazebroek previously had proposed a method for calculating average pressures in a bounded reservoir, involving division of the area into drainage volumes, for each of which an average pressure was calculated, before averaging these volumetrically to obtain a value for the whole reservoir. The accuracy of this proposal is investigated, and means are sought for estimating the drainage area for each well. By means of a model and numerical methods the pressure distribution and drainage boundaries at steady state are found for idealized reservoirs, good agreement being obtained by the 2 methods.

Photographs of the model flow-lines for a few well patterns are given, and the model technique is described. Examples of simple methods of estimating drainage boundaries are also given.

On the basis of the new studies it is concluded that the original proposal was sufficiently accurate for the intended purpose. G. D. H.

547. Concept of " hydraulic radius " in porous media. G. J. Harmsen. *J. Petrol. Tech.*, 1955, **7** (11), 53–6.—The hydraulic radius has been defined as

$$m = \frac{\text{Area of cross-section of capillary}}{\text{Perimeter of cross-section of capillary}}$$

or as $$m = \frac{\text{Volume of capillary}}{\text{Wetted surface of capillary}}$$

For cyl capillaries the definitions are identical, but in deriving Kozeny's relation Carman used the second definition.

It is shown that for any isotropic porous medium the numerical value of the ratio of total pore perimeter/unit cross-section and specific surface area/unit of bulk vol is $\frac{\pi}{4}$. This is the ratio of the apparent and true surface areas of the medium. This ratio does not reflect any structural property of a porous medium other than anisotropy.

The validity of Kozeny's relationship and of the capillary rise formula derived by Carman for consolidated sands is discussed. G. D. H.

548. Investigation of the filtration of a hydrocarbon liquid through a water-containing porous medium. S. L. Zaks and M. M. Kusakov. *Izvest. Akad. Nauk. SSSR. Otdel. Tekh. Nauk*, 1955, (11), 87–94.—Measurement of filtration rate (lab tests) of hydrocarbon liq shows permeability to be progressively decreased by addition of naphthenic acid. In presence of H_2O in the porous medium, simulating bound water, the relative permeability decreases with increasing H_2O content. At low naphthenic acid concn in the hydrocarbon liq filtering through moistened cores, lowering of permeability is mainly ascribable to presence of immobile (bound) water. In hydrodynamic calc of reservoir development allowance should be made for possible effect of H_2O on movement of oil in the stratum if H_2O content in cemented rocks of air permeability 250–400 mD is in excess of 10% of pore vol.

(Authors' summary.)

549. Influx of liquid to a well having a fissure in the pre-bore zone. M. I. Shvidler. *Izvest. Akad. Nauk. SSSR. Otdel. Tekh. Nauk*, 1955, (11), 95–100.—Mathematical treatment of hydrodynamic problem of the flow to the fissure of a hydraulically fractured well. (From authors' summary.)

550. How to find oil in (some) dry holes. R. J. Enright. *Oil Gas J.*, 26.12.55, **54** (34), 128.—A patented method of determining the formation factors of very small rock samples is outlined. The fragments are mounted in lucite plastic disks *ca* $\frac{3}{4}$ inch dia, and resistance measurements are made with the disk inserted in a brine resistivity cell. The formation factors are then calculated knowing the thickness and area of each fragment. C. A. F.

551. Fifth of U.S. oil from fields operating injection projects. L. Finch and F. M. Stewart. *Oil Gas J.*, 2.1.56, **54** (35), 91.—*Ca* 22% of oil production in the U.S.A. comes from fields which are operating under injection methods; it is estimated that ultimate recovery with secondary methods is 1·2–2·0 times the estimated primary recovery; ultimate primary recovery from known fields in the U.S.A. is estimated at *ca* 73 billion brl.

Methods of oil recovery are described briefly with diagrams. Primary methods are: dissolved gas drive, water drive, gas cap drive, and gravity segregation; and secondary methods are dispersed gas injections, pattern (5-spot) water flood, line water flood, line (peripheral) water flood, and gas cap injection. C. A. F.

552. Acid fracturing puts this field in the black. N. S. Morrisey. *Oil Gas J.*, 12.12.55, **54** (32), 82.—The use and results are described of acid fracturing of the limestone reservoir of the W. Short Junction field in Oklahoma. The field was discovered in 1948, but there was no development until 1954, when the discovery well was fractured. Present completion programmes involve perforating the pays and then fracturing with a mixture of gel acid and sand; some wells are washed with mud acid before fracturing.

Production is from truncated Hunton limestone, which pinches out against overlying Pennsylvanian. *Ca* 7000 acres have been semi-proved, and a further 100 wells are required to develop the field. C. A. F.

553. Report of operations, 1945 through 1954, Naval Petroleum Reserve No. 1, Elk Hills. F. W. Gooch and R. H. Adams. *J. Petrol. Tech.*, 1955, **7** (11), 13–20.—In 1945 production from the shallow oil zone was reduced from 65,000 to 15,000 b.d., with further reductions probable. Heavy withdrawals in the E. part had created an unbalanced pressure condition. Programmes were devised to find the best ways of protecting the various reservoirs. Evidence was found of fluid movements across many of the faults, the rapid advance of water along the more permeable zones, with the loss of oil to production, water entry into clean oil zones, oil movement into water sands, and of fluid movement from one sand to another via faults or wells. In an endeavour to correct or stop harmful fluid movements, various operations, appropriate to the particular problem, were undertaken. Gas injection was used, heavy withdrawals were attempted to encourage down-dip drainage; water injection was considered in areas where oil was moving down into water sands. Careful observations were made on the behaviour of the wells, and when necessary the programmes were modified.

Well equipment has been carefully checked, and the entire operations are planned to maintain the Reserve in readiness. Additional drilling has been for development and exploration, with some success. G. D. H.

TRANSPORT AND STORAGE

554. World's largest tanker-loading terminal. J. M. Dougary. *Oil Gas J.*, 23.1.56, **54** (38), 74.—The Mina-al-Ahmadi terminal in the Persian Gulf, belonging to Kuwait Oil Co, is described. This is the largest in the world, and can load 8 supertankers at once to a max rate of 126,000 brl/hr. G. A. C.

555. Pump-seal failure detector. W. B. Jarzembski. *Oil Gas J.*, 23.1.56, **54** (38), 67.—A capacitance-operated relay for automatic detection of seal failure on centrifugal-pump mechanical seals is described and its application in pipeline use detailed. G. A. C.

556. The effect of paint colours in reducing storage tank losses. E. L. Hoffman. *Pipe Line News*, 1956, **28** (1), 52–62.—Analysis of reported data and data obtained on 2 large cone roof tanks showed the effect of paint colour on evaporation losses from storage tanks. A " self chalking " white pigment paint was the most effective in reducing vapour and oil temp, and pastel colours, although inferior to white, were also effective. The data showed that the shell in contact with liq in the tank was responsible for the majority of the solar heat input. For floating roof and other vapour conserving tanks it may not be economical to use special reflective roof coatings. B. A. F.

557. Rural distribution of light petroleum gases. Anon. *Petrol. Times*, 3.2.56, **60** (1526), 123.—The Mallet plants at Bungay and Framlingham are described for controlled

evaporation of liq butane and its mixture with air, its storage, and distribution. G. A. C.

558. Booster station goes automatic. R. G. Deering. *Oil Gas J.*, 19.12.55, **54** (33), 92.—The automatic booster station at Flat Rock, Michigan, belonging to Detroit Southern Pipe Line Co, employs pneumatically-controlled throttle valves on both suction and discharge. The operation is described, and plan shows lay-out of controllers and valves. G. A. C.

559. New flexible coatings for marine lines. E. Sterrett. *Pipe Line News*, 1955, **27** (12), 37–42.—A new coating and coating process is described that can replace concrete for the weighting and protection of underwater pipelines. The coating is composed of an asphalt base weighted with stone or barites and with an addition of short glass fibres. It is extruded on to the pipe whilst hot, and a double wrap of fibre glass is applied. The coating is air-cured and then cooled with a water spray, and air hammers are used to give a compact coating well bonded to the pipe. The coating is flexible and corrosion resistant. B. A. F.

560. Hydraulics for pipeliners. Pt XV. C. B. Lester. *Pipe Line News*, 1955, **27** (11), 39–44.—Previous articles on pressure surge theory are summarized, and the theoretical work is compared with test data for various throughput rates. B. A. F.

561. The internal protection of sea-shore pipelines. G. Bombara and F. Gianni. *Riv. Combust.*, 1955, **9** (12), 940–53.—Among the chief problems of corrosion in petroleum plants the internal corrosion of sea-shore pipelines washed by means of sea water plays a big part from the viewpoint of economic losses and safety hazards. Various means of protection, electric, galvanic, and by inhibitors, have been investigated on lab scale, and the results have been correlated for a practical evaluation of the protective techniques.

(Authors' abstract.)

562. The Mole, latest pipeline tool. C. B. Lester. *Pipe Line News*, 1956, **28** (1), 42–4.—The unit consists of a clock, gyrocompass, and inclinometer to record horizontal and vertical direction at points within a pipeline. The data are recorded photographically at 15-second intervals and correlated with position data (recorded above ground) to give accurate details of the location of existing pipe. B. A. F.

563. Pipeliners see big year for natural gas and products pipeline. Various. *Pipe Line News*, 1956, **28** (1), 21–7.—Reports from 22 pipeline companies indicate a year of great expansion of natural gas pipelines, with good expansion in products and oil pipelines. B. A. F.

564. Consumable insert technique for pipe welding. R. D. Thomas. *Pipe Line News*, 1956, **28** (1), 28–31.—A new technique for pipe welding has been developed for applications where reliability of the weld is of great importance. A metal insert ring of special cross-section is tack welded on to the pipe ends which are to be joined together. The composition of the insert can be varied to give the required final joint composition. An inert-gas tungsten-arc is used to fuse the joint, and for the highest quality welds an internal purge of inert gas may be used. The resultant weld has a smooth internal surface, and defects in the weld, detected by visual inspection, can be rectified by re-melting. B. A. F.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

565. The elimination of hydrogen sulphide odours. R. C. Shea and J. Hackathorn. *Petrol. Refin.*, 1955, **34** (11), 191–3.—The elimination of hydrogen sulphide odours from a cat cracker is described in which waste flue gases are used to strip the hydrogen sulphide from the condensates produced by the cracking unit, absorber, and debutanizer towers.

The stripper is a 2½-ft dia, 30-ft high steel tower with only 7 ft of Raschig ring packing immediately above the gas inlet, but with a liq level maintained at 27 ft, which, besides providing the necessary contact time between the gas and the water, helps to minimize corrosion.

By this means it is claimed that 85–90% of the hydrogen sulphide is removed, giving an effluent containing between 480 and 780 p.p.m., whereas before it was 1600–2660 p.p.m. R. L. R.

566. How to save cooling water. Anon. *Petrol. Process.*, 1955, **10** (12), 1901–8.—In 2 separate articles, 2 instances are quoted when the use of water may be reduced or altogether eliminated. The first, developed by Sinclair Oil and Gas Co, eliminates the use of cooling water on natural gasoline plant compressor cyl. The second, developed by Magnolia Petroleum Co at Pegasus, Texas, practises the use of combination air and water cooling. J. H.

567. Flash flow pressure drop in heaters. F. L. Maker. *Petrol. Refin.*, 1955, **34** (11), 140–52.—The calculation of pressure drop in heater tubes with an evaporating fluid is usually done by time-consuming trial and error methods. A discussion is presented here of the methods available, with an example of Ludwig's method. This example is a simple and a fast way to compute pressure drop for pressures above atmospheric, where velocity pressure effects are small. A simple graphical way of integrating the pressure back from the known required conditions at the outlet, including velocity effects, is developed for vacuum conditions. The design method also lends itself to the ready study of alternative tube arrangements and flow rates. R. L. R.

568. Refining technology. V. A. Kalichevsky. *Petrol. Engr*, 1955, **27** (13), C19–29.—The various ways in which heat, pressure, and other physical factors are used in the refining industry to break down large mol into gasoline type mol are considered in detail under the headings hydrogenation, polymerization, alkylation, isomerization, and related processes. J. B. S.

569. Selection of catalytic reformer heaters. G. E. Rose and H. J. Born. *Petrol. Refin.*, 1955, **34** (11), 155–8.—A discussion of the unique problems in the selection of cat reformer heaters, which must have careful consideration if max economy and minimum shut-down time are to be realized. The selection of material and the minimum tube wall thickness are described, together with several different arrangements of the passes available for minimum pressure drop. The use of low calorific, high hydrogen content gases for the burners requires that they be very carefully designed and special precautions taken against flash back. (Cf. *Petrol. Refin.*, 1955, **34** (11), 153–4.) R. L. R.

570. From by-product hydrogen to anhydrous ammonia. J. H. Arnold and W. T. Dixon. *Petrol. Process.*, 1956, **11** (1), 62–6.—Built by Hydrocarbon Research Inc, a plant at Atlantic Refinery Co's Philadelphia refinery produces a nominal 100 tons/day anhydrous ammonia from hydrogen obtained from gas leaving an Atlantic Catformer which produces high octane gasoline from low grade naphtha. Products other than ammonia are propane and heavier hydrocarbons. Using an iron cat 97% conversion of hydrogen is obtained. J. H.

571. Combination unit lowers costs at new Bagdad refinery. N. Al-Pachachi. *Petrol. Process.*, 1956, **11** (1), 58–61.—One plant for five major operations—crude dist, vis-breaking, cracking, reforming, and vacuum flushing—lowers operating costs very considerably at the Iraq Government's new 24,000-

b.d. Daura refinery, Bagdad. Biggest savings are in capital investment, utilities, and labour. Operating flexibility is excellent. Products from the 36° API Kirkuk crude are gasoline, kerosine, and gas, diesel, fuel, and bunker "C" oil. J. H.

572. Sea-water strainers at Fawley. Anon. *Petroleum, Lond.*, 1956, **19** (1), 21.—The use of sea water as the cooling medium in heat exchangers presents problems due to the very variable conditions which are met with in estuarine waters. The coarse screen originally employed was impossible to clean without interrupting the flow of water, and also allowed much debris to pass through. Twin strainers were then installed, and the modifications subsequently employed to cut down the time and manpower required for changing over and cleaning are described. J. B. S.

573. Gas conditioning to-day. A. L. Kohl and F. C. Riesenfeld. *Petrol. Refin.*, 1955, **34** (11), 209–13.—The article describes some of the recent developments in gas conditioning technology. Detailed description of plant and processes is avoided, and it deals specifically with particulate matter removal, gas purification, and dehydration.

The removal of solids by entrainment or impingement is discussed briefly and also means of measuring the efficiency of removal.

The treatment of gas for removal of hydrogen sulphide and carbon dioxide is discussed, and some of the major problems encountered in the Amine process are presented, together with a study of some of the problems of corrosion. R. L. R.

574. To the hills instead of the river. D. P. Thornton, Jr., *Petrol. Process.*, 1956, **11** (1), 49–51.—Socony Mobil Oil Co's Casper, Wyoming, refinery, located on the North Platte River, disposes of its effluent streams in a 750-acre area of sandhills instead of in the river. The effluent containing phenols as high as 50–75 p.p.m. is pumped at a max rate of 200 gal/min to natural basins within the sandhills, where most of the water evaporates owing to the low humidity of this region. Details of effluent control are given, together with drawings and photographs. J. H.

575. The choice, design, characteristics, and maintenance of centrifugal pumps. Pt III. F. B. Applegate. *Petrol. Engr*, 1955, **27** (13), C31–6.—The "net inlet head" for a pump is defined, and methods are given for its determination for the pump and the system, 2 examples being worked. Materials of construction for the various parts of pumps, casing, impeller shafts, etc., are also considered. J. B. S.

576. The selection of direct-fired tubular heaters. J. Y. Thirwell. *Petroleum, Lond.*, 1955, **18** (10), 361.—The article attempts to give the engineer some guidance as to how and why various designs are used, the major points considered being initial costs, running costs, space limitations, and special conditions to be observed with the fluid to be heated. It is concluded that if fuel costs are low or heat absorption duty small, then radiant heaters of the cyl or rectangular box type are suitable. If fuel costs are high, a heater with convection and radiant heating surfaces should be adopted. J. B. S.

577. West Coast's latest coking plant. J. Stumm. *Petrol. Engr*, 1955, **27** (13), C6–8.—Heavy crude oil (15° gravity) is converted into high quality feed stocks for further processing and refining, the only finished products being coke and sulphur. The heavy crude oil is broken down into gas, gasoline, and gas oil, leaving only coke as residue. The gas from the coking plant contains H_2S, which is removed and converted to liq sulphur, the remaining gas being used as fuel. J. B. S.

578. How to specify heat exchangers. W. E. Glausser and J. A. Cortright. *Chem. Engng*, 1955, **62** (12), 203.—Design features of exchangers are discussed. Standard fittings and designs are described, and rough dimensions for layout are given, based on length and dia. D. J. S.

579. How to find the best site for new plant. D. V. Bierwert and F. A. Krone. *Chem. Engng*, 1955, **62** (12), 191.—The selection of plant sites is reduced to a 6-stage process from an overall analysis of the problem through detailed analysis of factors to the management decision. D. J. S.

580. Charts simplify the job of designing your reactor system. T. M. Jenney. *Chem. Engng*, 1955, **62** (12), 198.—9 charts are presented to enable engineers to design reactors simply. The theoretical basis for the charts is given, and examples are worked. D. J. S.

581. Drying: design and costs. W. C. Lapple, W. E. Clark, and E. C. Dybdal. *Chem. Engng*, 1955, **62** (11), 177.—Following an article in which the underlying principles of dryers were explained and in which dryers were classified, a second article on design and costs is presented. The steps in the selection of a dryer are given, along with the derivation of equations used in the calculations for 6 types of dryer. Details of the methods used to obtain costs and tables of individual costs are given. D. J. S.

582. Chemical engineering fundamentals: reactor design problem, simple reaction. T. E. Corrigan and E. F. Young. *Chem. Engng*, 1955, **62** (12), 211.—A simple problem in the selection of a reactor is given and solved, showing the economic factors involved. Cost calculations are given. D. J. S.

583. Simple lagging for steam pipes. J. P. W. Houtman and A. Husain. *Ingenieur, 's Grav.*, 23.12.55, **67** (51), Ch. 93–6.—The insulating properties of so-called "java-lagging" consisting of bamboo, rice straw, and a coating of cow-dung and lime are being investigated. A description of the apparatus is given, and the efficiency of the java-lagging is compared with that of more conventional insulating materials. The conclusion is reached that rice straw is the more active of the 3 components, and when used in thick layers with a protective coat of cement compares favourably with asbestos, kieselguhr, etc. 3 figs, 2 tables. G. F. T. C.

584. New liquid extractor. M. R. Cannon. *Oil Gas J.*, 23.1.56, **54** (38), 68.—A liq extractor column is described which depends on pulse flow for its operation, and is proving successful in commercial applications. G. A. C.

585. Help in picking the right tray. R. Katzen. *Chem. Engng*, 1955, **62** (11), 209.—Some unpublished data on cost and performance of trays are given to simplify tray design; Uniflux trays, Flexitrays, Turbogrid, and Perforated trays are described, and references are given to work on these trays. D. J. S.

586. Know your mechanical seals. J. S. Swearingen. *Chem. Engng*, 1955, **62** (11), 213.—Diagrams are used to explain the operation of mechanical seals, and maintenance and breakdowns are discussed. D. J. S.

587. Forced-draft cooling tower stages a comeback. A. Smith. *Oil Gas J.*, 19.12.55, **54** (33), 51.—Pure Oil Co have installed an 8-fan-cell cooling tower, arranged with 4 cells back-to-back. This arrangement results in better distribution of air with greater drift-eliminator area and increased discharge velocity. Tower cools 36,570 g.p.m. from 120° to 90° F at 82° F wet bulb temp. G. A. C.

588. Chemical cleaning is cheaper too. J. C. Reidel. *Oil Gas J.*, 19.12.55, **54** (33), 75.—Tables list typical deposits found in columns, condensers, coolers, and heat-exchangers on which chemicals are effective, the method being stated for each job. Pipe stills, cracking units, waste heat boilers, alkylation units, and tanks present cleaning jobs which chemicals can carry out efficiently. G. A. C.

589. Stage efficiencies of liquid extraction columns. R. E. Treybal. *Industr. Engng Chem.*, 1955, **47** (12), 2435–6.—Stage efficiencies of pilot plant extraction equipment are sometimes difficult to evaluate due to "pinched" sections at the ends of the column. In these cases it is possible to take samples at points removed from the pinched sections in order to estimate the efficiencies of the intermediate region. Usually such samples contain both phases which tend to come to equilibrium before an analysis can be made. A method is described that enables the operating conditions to be calculated from the equilibrium analysis of the sample, and hence the efficiencies of the intermediate sections can be determined. B. A. F.

ABSORPTION AND ADSORPTION

590. Correlation and practical application of results from laboratory and practice. K. Recovery of crude benzene. Practical part. W. Mantel and H. Hansen. *BrennstChemie*, 1956, **37** (1–2), 19–26.—Formulæ developed in the theoretical part for calculating sorption loss in the binary system pure benzene–wash oil are applied to the multi-component system crude benzene. To simplify calculation the multi-component crude benzene is divided into 4 fractions considered sorption technically as unitary components. The course of the curves for these components and for crude benzene is checked for dependence on change of gas and oil quantities—influenced by sorption—and on Henry's const. For works use the calculation is simplified; operational val are introduced into the equation, and sorption-tech val for operational conditions calc and entered in a diagram. Examples demonstrate use of simplified equation and diagrams. R. T.

591. Determination of hydrogen sulphide from LP gas in liquid phase. M. Taramasso and A. Piccinini. *Riv. Combust.*, 1955, **9** (12), 933–9.—The method consists of the direct absorption of hydrogen sulphide from LP gas samples in liq phase by shaking in an acrylic resin gas bottle with zinc acetate soln. For determination of zinc sulphide thus produced the methylene blue method has been used. Technical details and analytical data are given. (Authors' abstract.)

SOLVENT EXTRACTION AND DEWAXING

592. Direct recovery of white paraffin with selective solvents. E. von Pezold. *BrennstChemie*, 1956, **37** (1–2), 9–14.—A new lab method for abstracting white paraffin—to standard set. pt., colour, and oil cont—from lignite tar, with selective solvents, is discussed fully, and the apparatus illustrated. Yields and operational speed are > those from conventional processes. 41 refs. R. T.

CRACKING

593. Comparing olefin unit feedstocks. J. R. Fair, T. K. Perkins, and H. F. Rase. *Petrol. Refin.*, 1955, **34** (11), 185–9.—A discussion on the possibility of using butane instead of propane as a charge stock for ethylene and propylene production. Main advantages of this seem to be the simplification of separation of the products, since no propane is produced in butane cracking and pure propylene is obtained direct from the depropanizer, and also the fact that for butane feed there is a greater ratio of propylene to ethylene in the products.

The article is restricted to the production of ethylene and propylene by cracking of butanes and a comparison with the cracking of propane, although references are given to pyrolysis yields and the practice for ethane and propane feed stocks. R. L. R.

594. High temperature vapour phase cracking of hydrocarbons. H. R. Linden *et al.* *Industr. Engng Chem.*, 1955, **47** (12), 2467–82.—Results are presented from a study of vapour phase cracking of various hydrocarbons, natural gas liq, and crude shale oils at high temp in a continuous flow reactor. B. A. F.

HYDROGENATION

595. Catalytic dehydrogenation of *iso*pentane. N. I. Shuikin *et al.* *Izvest. Akad. Nauk. SSSR. Otdel. Khim. Nauk*, 1955, 952–3.—Tests at 527° C, atm pressure, cat composed of Al_2O_3 90·7, Cr_2O_3 5·6, K_2O 3·7 (mol %), regenerated by air at 550° C. Product, b.p. 20°–148° C, contains 38% *iso*pentenes (33% on feed), analysis given. V. B.

CHEMICAL AND PHYSICAL REFINING

596. Adsorption of sulphur compounds and aromatic compounds from gas oil. H. I. Waterman and W. C. van Zijll Langhout. *Chim. et Industr.* (*Génie Chim.* suppl.), 1955, **74**, 161–72.—Brief introduction outlining theory of adsorption, with particular reference to applications in petroleum field, followed by details of experiments made with 3 gas oils (S 1·3%, mean mol. wt. 230) using Al_2O_3 (preheated at 500°–550° C) as adsorbent. 2-cycle passage through column, using *iso*C_5H_{12} as eluant for paraffins–naphthenes and EtOH to elute aromatics and S cpds. S content of first fraction can be as low as 0·05% (84% yield). Description is given of semi-continuous operation, using C_5H_{12} and toluene as eluants for (paraffin–naphthene) and (aromatics + S cpds) fractions respectively; S content of pentane fraction *ca* 0·3%. Results are given in detail, including amounts of solvents required and ratio Al_2O_3–oil for various degrees of desulphurization. V. B.

SPECIAL PROCESSES

597. How Condor refinery recovers sulphur from Middle East crudes. M. Mortara. *Oil Gas J.*, 23.1.56, **54** (38), 70.—The Condor refinery nr Milan, Italy, processes Middle East crudes with sulphur content ranging from 1·5 to 2·5 wt% and operates a plant to convert H_2S to H_2SO_4 in 4 successive steps using the Monsanto–De Nora patent process. G. A. C.

598. Reforming—a new refining process. J. Evans. *Petroleum, Lond.*, 1955, **18** (11), 419.—This process consists of an integrated unit of feed prefractionator, reaction section, stabilizer or debutanizer, and extraction section. The reaction section operating under mild conditions produces an effluent having an O.N. of 75–85 containing 35–45% aromatics. The extraction section separates this stream to produce 100 octane fuel containing 55–60% aromatics. Yield figures compare favourably with those for "once-through" operations. J. B. S.

599. Grange chemicals plant in production. Anon. *Petrol. Times*, 3.2.56, **60** (1526), 127.—The Grangemouth plant of Grange Chemicals Ltd, which is producing high-quality dodecylbenzene (the chief active constituent of most domestic synthetic detergents) at over 10,000 tons/year is briefly described. G. A. C.

600. The application of electrical precipitation to distillate treating. R. J. Phillips. *Petrol. Engr*, 1955, **27** (13), C9–12.—Treatment of all dist from naphtha to lub oil boiling ranges with such agents as caustic, water, and acid can be accomplished more effectively with the aid of electrical precipitation. Added coalescing provided by the electrical field permits lower chemical consumption and drastic reduction in carry over of addition agent. Report describes equipment and use in detail. J. B. S.

601. A review of industrial catalytic desulphurization processes for gasoline. R. Lipovsek. *Nafta* (*Yugoslavia*), 1955, **6** (10), 333–8.—The main technological advances: Perco Cyclover-

sion, Autofining, Hydrofining, Hydrodesulphurization, and Unifining catalytic desulphurization processes, are briefly described. (Author's abstract.)

602. Sulphur from petroleum—recovery facilities at Fawley refinery. K. A. F. Edwards, G. I. Krzymorski, P. Laister, and I. McCullum. *Petroleum, Lond.*, 1956, **19** (1), 5.—Certain refinery streams contain H_2S and are potential source of elemental sulphur. At Fawley facilities installed consist of 3 Girbitol units employing 20% w/w diethanolamine soln as the absorbing medium. H_2S from these units is burnt under controlled conditions, giving liq sulphur. The process is described in detail, and flow diagrams are given. J. B. S.

METERING AND CONTROL

603. Pneumatic relays for process control. R. D. Cowherd. *Chem. Engng*, 1955, **62** (12), 185.—Electrical relay controls and pneumatic controls are discussed, and analogies are drawn between them; a simple case, that of a motor starter, is solved for each type, and then the general principles of pneumatic circuits are discussed. D. J. S.

PRODUCTS

CHEMISTRY AND PHYSICS

604. Relationship between viscosity and structure. A. Crozier. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1467–81.—Study of published data relating to homologues and isomers in alkyl*cyclo*-pentane, -hexane, -heptane, and alkyl-benzene series. In case of position isomers visc *cis* form is always > visc *trans* form. Various visc–structure relationships that have been proposed are critically discussed. V. B.

605. Artificial ignition at low pressure. H. Guénoche, E. Fréling, and P. Dugleux. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1209–23.—Studies on mixtures of *n*-propane with dry air, free from CO_2, at pressures of 50–300 mm; C_3H_8 content up to 10%; glass apparatus; spark ignition; 3 sizes of combustion tube (all 5 cm dia). Ignition type, and inflammability curves, are of same general pattern for artificial and for spontaneous ignition, both of which are initiated by active centres once concn of latter has attained a sufficient value. Anomalies noticed on artificial ignition curves must be ascribed to physical factors, such as tube characteristics or ignition source. V. B.

606. Coefficient of volume expansion for petroleum waxes and pure *n*-paraffins. P. R. Templin. *Industr. Engng Chem.*, 1956, **48** (1), 154–61.—Thermal expansion data are reported for a number of petroleum waxes, one semi-pure and 6 pure *n*-paraffins. The data include total expansion associated with solid–solid and solid–liq phase changes, coeff of vol expansion for each phase, freezing and transition temp, and the specific vol at these temp. Correlations of vol data with carbon number are reported, together with a limited amount of data on the effect of pressure on the f.p. of *n*-C_{18}. B. A. F.

607. Prediction of vapour–liquid equilibrium data. I. H. Spinner *et al.* *Industr. Engng Chem.*, 1956, **48** (1), 147–53.—Empirical equations are given for determining the vapour–liq equilibrium data for binary and ternary systems that do not necessitate knowing the equilibrium values for the system. The primary data for binaries are the binary data for each component with a third component, and the primary data for the ternaries are the data for 2 of the 3 binary systems. The equations are in a form suitable for rapid dist calculations. B. A. F.

608. Vapour–liquid equilibria at atmospheric pressure. J. H. Weber. *Industr. Engng Chem.*, 1956, **48** (1), 134–6.—Data were obtained for the systems 2,2,5-trimethylhexane–ethylbenzene and 1-octane–ethylbenzene at atm pressure, the data being smoothed by the Van Laar equation. The systems departed from the ideal only to a small extent. B. A. F.

609. Solid–fluid interactions in fixed and moving beds. N. R. Amundson *et al.* *Industr. Engng Chem.*, 1956, **48** (1), 26–50.—General solutions have been obtained to the mathematical equations for heat generation, heat release, and heat exchange between fluid and solid in fixed and moving beds. The solutions are of use for the design of reactors, adsorbers, and pebble heaters. B. A. F.

610. The problem of rheology—a current appraisal. A. V. Brancker. *Petroleum, Lond.*, 1955, **18** (10), 373.—Rheology is concerned with the flow or deformation under stress of any substance—gaseous, liq, solid, visco-plastic, etc. Under certain stress stimuli, elastic solids exhibit flow properties and viscous materials react elastically. Problems in fluid flow, mass transfer, heat transfer, etc., often depend for their solution on equations involving visc. The effect of temp and pressure on visc is clarified by rheological considerations, and examples are given of the basic problems of rheology. J. B. S.

611. Chemical engineering fundamentals: general considerations in reactor design. T. E. Corrigan and E. F. Young. *Chem. Engng*, 1955, **62** (11), 217—Back mixing has been shown to have a considerable effect on simple reactions (*cf.* Abs. **199**, 1956), and this article extends the equations for second and fractional order reactions, and graphical methods of obtaining solutions are described. D. J. S.

612. Charcoal adsorption equilibria for light hydrocarbons. C. J. Walters. *Industr. Engng Chem.*, 1955, **47** (12), 2544–7.—The 60° F adsorption isotherms were obtained for pure methane, propane, and *n*-butane over the pressure range 0–760 mm Hg using freshly reactivated Columbia G charcoal. Binary and ternary mixtures were investigated at 60° F and 760 mm pressure, and a correlation based on the Polanyi adsorption potential and including an activity coeff gave fair approximation to experimental results. B. A. F.

613. Composition and tensile strength of paraffin waxes. R. T. Edwards. *Industr. Engng Chem.*, 1955, **47** (12), 2555–8.—An investigation into the composition–tensile strength relation of 6 waxes showed that: (1) the max tensile strength of a paraffin wax was associated with an optimum content of non-normal hydrocarbons and that non-normal hydrocarbons varied in this respect; (2) the most effective non-normal hydrocarbons were solid at test temp and of considerably higher mol. wt. than the normal paraffin content. B. A. F.

614. Binary azeotropic systems. J. Joffe. *Industr. Engng Chem.*, 1955, **47** (12), 2533–5.—An algebraic method based on the Van Laar equations has been developed for the calculation of the effect of temp on the composition and pressure of azeotropic mixtures. B. A. F.

ANALYSIS AND TESTING

615. Simplified rapid methods for determining the softening point of resins and bitumens. K. M. Oesterle. *Schweiz. Arch. angew. Wiss.*, 1956, **22**, 1–9.—Need for quicker methods than present recognized soft. pt. tests is discussed. 2 procedures are described: (1) ball infiltration method, in which temp is taken at which ball sinks, under its own weight, half-way into test material; (2) needle zero-pressure method, needle is heated till it just penetrates into test material, as indicated by deflexion of balance on which latter is placed. This method is the preferred one, and its advantages, *e.g.* avoidance of necessity for any alteration of physical form of test material, are discussed. Definition of soft. pt. is suggested, being that temp at which an infinitely thin needle under an infinitely small pressure penetrates the resin surface to an infinitely

small extent; obtainable on apparatus described by extrapolation of test results to zero pressure, although for technical purposes a single reading suffices. Comparison is given of results on various materials (including bitumens) by different procedures (K-S, R & B, capillary tube, hot table, needle zero-pressure). V. B.

616. Radiography—a maintenance tool for lead lining inspection. V. P. Bracken and W. Skiba. *Petrol. Process.*, 1955, **10** (12), 1888–9.—Radiation can provide a long needed maintenance tool for spotting possible failures in lead lined process vessels. The technique developed at Esso Standard Oil Co (U.S.A.) has worked successfully on a 36-ft tower in sulphuric acid service, and has the advantages that the vessel does not have to be dismantled, reducing offstream time and product losses and tiny defects—not easily detected by ordinary observation—can be corrected before they cause trouble. This method can be used for the inspection of lead lined vessels during fabrication. J. H.

617. Direct estimation of mineral material content of coals. W. Radmacher and P. Mohrhauer. *BrennstChemie*, 1956, **37** (1–2), 26.—Corrections to article, this *Journal*, 1955, **36** (15–16), 236–9 (*cf.* Abs. **69**, 1956). R. T.

618. Evaluating physical properties of coatings. J. I. Richardson. *Chem. Engng*, 1955, **62** (11), 242.—Properties other than chemical are important in the selection of coatings; permeability, thickness, adhesion, flexibility, and abrasion resistance are discussed and illustrated. D. J. S.

619. Hydrocarbon identification by means of dispersion curves. I. V. Obreimov and T. N. Shkurina. *Izvest. Akad. Nauk SSSR. Otdel. Khim. Nauk*, 1955, 890–8.—Ref index of 14 hydrocarbons (*n*- and *iso*-paraffins, olefins, naphthenes) determined at λ 2500–6500 A; in this range temp coeff of n is independent of λ. Constants of Sellmeier equation are calc, and it is shown that λ_0 depends on number and situation of double bonds, whilst f (effective vibrator intensity) varies with mol structure. V. B.

GAS

620. Oil and the British gas industry. Anon. *Petroleum, Lond.*, 1956, **19** (1), 17.—A review is given of the work of the Gas Council. This includes the large scale exploration programme for natural gas undertaken with technical aid of the D'Arcy Exploration Co, the possibility of importing liquefied natural gas, and the production of town gas from oil at the Isle of Grain refinery. J. B. S.

ENGINE FUELS

621. Combustion in gas turbines. Various. *Gas Oil Pwr*, 1956, **51**, 18–22.—Summary of 4 papers presented to the Gas Turbine Section of the Joint Conference on Combustion, London, Oct. 1955.

Coal firing for the open-cycle gas turbine: a comparison of methods. H. R. Hazard. 4 basic firing methods are discussed: with pulverized coal, as producer gas, in a cyclone furnace, and in a spreader-stoker. It is considered that coal properties such as volatile matter, ash fusion temp, ash content, caking properties, etc., must be considered when selecting coal-firing equipment.

Combustion of blast furnace gas in a gas turbine. A. E. Hershey. Deals with the combustion of low energy fuels in a gas turbine. The first section discusses the design of combustion chambers most suitable for low energy fuels, and this is followed by performance data collected in a field test. Combustion efficiency was >95% provided that the gas inlet temp was kept at >400° F. The question of corrosion was also examined, and it was concluded that blast furnace gas is not inferior to natural gas in this respect.

Operating experience with combustion equipment in industrial gas turbines. C. Kind. An analysis of faults likely to develop in injector nozzles and combustor elements whilst operating with 6 different oil fuels under different conditions.

Combustion of residual fuels in gas turbines. P. T. Sulzer and I. G. Brown. Gives results of field tests carried out on the gas turbine in the *Auris* and the 20,000-kW set at Weinfelden. To obtain data on corrosion, test specimens were placed in the duct before the turbine; results are given in tabular form. The effect of additives in the fuel is discussed. Kaolin is favourable in reducing depositions, although its particle size must be closely controlled; corrosion may be inhibited by oil-soluble cpds of Zn and Ba. The water-soluble $ZnSO_4$ was also used. On the Weinfelden plant ash deposition precluded the regular use of residual fuels without additives. (*Cf.* Abs. **622–3**, 1956.) H. C. E.

622. Combustion in theory and practice. T. F. Hurley. *Nature, Lond.*, 1955, **176**, 1239.—Report of a Joint Conference held in Boston (June 1955) and in London (Oct. 1955), dealing with fundamental aspects, boilers, industrial furnaces, I.C. engines, and gas turbines. The last 4 sections were mainly practical in nature, and discussed topics including fuels, design of equipment, operating difficulties, and instrumentation.

The proceedings showed that basic theory and practice are far apart, and various reasons were given. Thus the scientist and the engineer have different approaches, and it would help to conduct research by joint teams of experts. Also the chemistry of combustion is complex, whereas the engineer must be quickly able to adapt plant to new conditions.

Throughout, emphasis was placed on the effect of impurities in the fuel; combustion problems became apparent only when physical factors accentuate the presence of, *e.g.* Na, S, or V. It was stated that the max heat-release observed during combustion of liq hydrocarbons under specified conditions was 3×10^8 B.t.u/cu. ft/hr/(atm)$^{1\cdot8}$, and that in the final stages of combustion the slow controlling step was the oxidn of CO. This max value is much greater than that usually observed in practice, but values of the same order may be observed in I.C. engines. In the gas turbine most of the heat-release occurs in *ca* $\frac{1}{4}$ of the combustion space, the remainder of which is used for the oxidn of H_2 and CO. Investigations are proceeding on the physical and chemical properties of fuel ash, and the use of additives to affect the combustion process, reduce the effect of impurities on deposits, and reduce wear and tear.

Summarizing, it would seem that the engineer has developed combustion techniques which in the past have been good enough to make the actual process of combustion a minor problem. More recently he has found it necessary to undertake experimental work on associated phenomena, but so far little use has been made of the fundamental physics and chemistry of combustion mechanism. (*Cf.* Abs. **623**, 1956.) H. C. E.

623. Joint Conference on Combustion. Various. *Gas Oil Pwr*, 1955, **50**, 295–9.—Summary of 5 papers presented to the I.C. Engine Section of the Joint Conference on Combustion in London, Oct. 1955.

Combustion in dual-fuel engines. N. P. W. Moore and R. W. S. Mitchell. Normally these engines burn mainly gas, with a small amount of fuel oil, and at weak gas–air mixtures and low loads combustion is incomplete. Performance can be improved by throttling and by preheating the inlet air. The problem is not so acute in larger engines (cyl *ca* 10-inch bore), but with these engines injection nozzle cooling is necessary.

The lower inflammability limits of gas and pilot oil, determined by engine tests, are similar to those of CH_4 as determined by lab bomb tests.

Combustion in large diesel engines. P. Jackson. The problem is to operate efficiently on residual oil as fuel. Acids formed during combustion are prevented from reaching the crankcase by using a gland around the piston rod. The amount of sludge formed is increased if the liner is too cool and if the injection conditions are such that some of the fuel droplets are not completely burned.

Combustion products and wear in high-speed compression-ignition engines with particular reference to the use of lower grade fuels. W. T. Lyn. Using metal test pieces in the cyl

head and exhaust pipe of a small engine (cyl bore 3½ inches), it was found that neither corrosion nor S content of deposits were related to S content of the fuel. With heavy oil, however, the deposits were much higher in quantity and harder in character; and comparative analyses showed that those from the heavy oil contained more vanadium. When the engine was fitted with a scraper ring above the gas rings wear using heavy oil was about equal to wear using gas oil; without it wear with heavy oil was 6 times as great.

Combustion in diesel engines with divided combustion chambers. Pt I, H. Hoffman; **Pt II,** H. Lang; **Pt III,** O. Cordier. 3 types of combustion chamber are described; all fitted with a narrow heat-insulated throat. 2 types have axial throats and one a tangential throat, and the relative sizes of the precombustion chambers vary considerably. It is deduced that all these types have approx equal mixing efficiency, and hence the power output for all types is about the same.

High-compression turbocharged spark-ignition gas engines. W. M. Kauffman. 2- and 4-stroke turbocharged gas engines are now used in the U.S.A. for pumping gas through pipelines. Combined with after-cooling and humidification of charge air, turbocharging gives b.m.e.p. of 137–200 p.s.i. for 4-stroke and 96–135 p.s.i. for 2-stroke engines. The C.R. may be as high as 15 : 1. Methods of operation are briefly described.
H. C. E.

624. Life tests on a small high duty [diesel] engine with particular reference to chrome bores. B. W. Millington. *Gas Oil Pwr*, 1955, **50**, 343–7.—In this series of tests using a single-cyl engine of bore 5 inches and stroke 5½ inches, the effect of different fuels on rates of wear was assessed. The wear of liner at 120° C after 100 hr was measured using as fuel gas oils containing 0·8–1·0% S; in all cases the wear was negligible. The article contains a short discussion on the effect of even small concn of SO_3 in a water vapour atmosphere in raising the dew point very appreciably. It is stated that under conditions obtaining in engine cyl the Cr is readily attacked by high concn of sulphuric acid at temp near 100° C. Above 130° C corrosion is again decreased. H. C. E.

625. Injection phenomena in high-speed engines. H. Wassenaar. *Gas Oil Pwr*, 1955, **50**, 342, 347.—Described experiments made with an injector which sprayed fuel into a pressurized chamber fitted with windows through which the spray could be observed stroboscopically. The conditions leading to after-dribble, secondary injection, and leakage were explored. H. C. E.

626. Jet fuel thermal stability. C. M. Barringer, M. W. Corzilius, and J. D. Rogers. *Petrol. Process.*, 1955, **10** (12), 1909–11.—The stability of jet fuels presents an increasingly important problem, especially if the fuel supply acts as a heat sink in high-speed flight. Heat forms sludge and insoluble residue in the free supply, clogging fuel filters and burner nozzles. Most tests on fuel stability were static and involved high temp bombs. The Erdco jet fuel coker, described in the article, has been selected as a standard test apparatus. It is a high pressure unit yielding results correlating with those of fuel scale rigs. J. H.

627. Control of engine knock through gasoline and oil composition. Pt I. C. L. Fleming, N. V. Hakala, L. E. Moody, R. W. Scott, and C. O. Tongberg. *Petroleum, Lond.*, 1956, **19** (1), 18.—A detailed field study was carried out by the Esso Laboratories to investigate the effect of fuel volatility on octane requirement increase. Also included in the study was a comparison of multi-visc grade oil and conventional lubricant. Tests were carried out in current cars and cars equipped with future type high-C.R. engines. J. B. S.

GAS OIL AND FUEL OIL

628. Hydrogen fuel. R. D. Reef. *Petrol. Refin.*, 1955, **34** (11), 153–4.—A discussion on the problems of burning gaseous fuel containing free hydrogen. These are mainly the prevention of flash-back and the difference in the flame vol produced for any specific heat release with normal paraffinic and olefinic gases and with such gases in combination with free hydrogen.

However, gases containing a high mol percentage of free hydrogen can be burnt satisfactorily with special venturi nozzles which will admix large vol of primary air and are designed to allow for the presence of greater than normal flame vol for a given heat release. No special tile or refractory design is necessary in the furnace itself. R. L. R.

629. Residual oil for furnace fuel. E. H. Palchik. *Petrol. Refin.*, 1955, **34** (11), 161–3.—An up-to-date review of the problems encountered in the use of heavy fuel oil for furnace heating is given. The handling of the fuel and the oil heater equipment are dealt with; maintenance and operating factors which technically tend to limit the broader use of heavier residual fuel oils are reviewed also. R. L. R.

LUBRICANTS

630. Handle your lubes with care. R. K. Gould. *Petrol. Process.*, 1956, **11** (1), 46–8.—Storage of lubricants under ideal conditions ensures better stability. Methods are forwarded to improve storage conditions. Leakage of oil, apart from the waste involved, may also be a safety hazard; contamination should be avoided, and exposure of lubricants to either abnormally high or low temp can result in temporary or permanent damage, depending upon the nature and composition of the product. J. H.

631. Testing of lubricants for lubricity by means of the Wieland and 4-ball apparatus. III. M. Brunner and R. Pedrini. *Schweiz. Arch. angew. Wiss.*, 1955, **21**, 392–404 (*cf.* Abs. **481**, 1956).—Detailed description of construction and operation of 4-ball machine and discussion of various criteria suggested for interpretation of tests therewith. Results of numerous tests are presented graphically. Lubricants with mild E.P. properties may show up relatively worse on 4-ball as against Wieland tester owing to chem resistance of Cr steel balls of former; preference given to chem active materials by 4-ball tester confirmed by relatively worse results (as against Wieland) given by colloidal graphite and MoS_2 additives. Negligible effect of oil visc on results is shown by closely similar curves obtained with additive-free petroleum products in visc range (20° C) 4/2000 cS. Previous favourable effect on lubricity of Pb salts in used oils from spark-ignition engines confirmed, used oils from diesel engines do not show this effect nor do used spark ignition engine oils after filtration. V.I. improvers (*e.g.* Acryloid 710) do not decrease performance of E.P. oils in 4-ball test. Results on synthetic lubes are given (silicones worst, polyalkylglycols best). 4-ball apparatus is applicable to testing of greases, and results on various greases, including effect of additives thereon, are given. In general, results with 4-ball tester correspond satisfactorily with findings in practice. V. B.

632. Solid lubricant for parts operating under dry friction conditions. P. E. D'yachenko, O. E. Kestner, and L. A. Chatynyan. *Izvest. Akad. Nauk. SSSR. Otdel. Tekh. Nauk*, 1955, (12), 128–30.—Experiments using disk lub tester (Cr bronze, sliding speed 6 m/sec, load 3·5 kg/cm², room temp and 500° C, test duration 20 minutes) using graphite and MoS_2. Lubricants applied either by rubbing on or else in suspension in corn molasses. Results indicate marked reduction of coeff friction (to *ca* 0·16 as against stable value of approx 0·45 when running dry) in all cases; wear rates show MoS_2 slightly better than graphite, and for both lubricants application by rubbing was slightly more effective than with carrier liq.
V. B.

633. Some problems in lubrication and the substances called additives. A. Towle. *Gas Oil Pwr*, 1955, **50**, 320–2, 327.—Following a definition of "additive," individual substances

are considered in turn, and the application of treated lub oils to engines is discussed.

Colloidal graphite does not lead to improved performance in engine and rig tests. MoS_2 is used in wire-drawing, etc., and functions by the formation of a sulphide layer on the metal surface. Pour point depressants (polymerized phenols or esters) act by coating the small wax crystals as they separate out and so prevent their coalescence, and are used at concn between 0·1 and 1%. V.I. improvers (usually long-chain polymers) are in the colloidal state at low temp; as the temp of the oil is increased the polymer dissolves and so maintains the visc of the oil. Oxidn inhibitors are oil-soluble cpds of one of 4 types, and act either as cat poisons in the metal-cat reaction of peroxides from oils, or by decomposing the organic peroxides as they are formed. Detergents may be one of 5 organic types, and act by keeping in suspension the carbonaceous material formed in the engine cyl. Anti-foam agents are silicone polymers which prevent formation of large amounts of entrained bubbles in the oil system. Rust inhibitors—petroleum sulphonate, etc.—are used in oils for engines which have long periods of standing, or idle periods after operation for periods insufficiently long for complete warm-up.

The final section deals with the use of oils containing additives in road transport diesel engines of the following types: Leyland, Daimler, Gardner 6LW, and AEC 9·6-litre engines. With medium- and low-speed stationary and marine engines the problem is similar if the crankcase and piston lubrication systems are not separate. In such cases oil containing additives enables the engine to run on boiler fuel of high S and ash content; but excessive top ring groove wear still remains a problem. With engines having a separate lub oil supply to the pistons the rate of lub oil application is insufficient to prevent wear. H. C. E.

634. Reclamation of used oils. 6. E. G. Ellis. *Sci. Lubric.*, 1955, **7** (8), 34–8.—Details are presented of a new coolant clarifier wherein the filter medium is automatically renewed from a roll of the material as it becomes ineffective. Where the smaller quantities of grease used have rendered less urgent its reclamation, its increasing use is focusing attention on reclamation possibilities, and procedure for the recovery of roll-neck grease in a steel rolling mill is described, together with the reabsorption of sub-standard recovered material into general use. The desirability of a reliable test routine for reclaimed lubricants which can be effected by the user without elaborate equipment is emphasized and a visual method for the estimation of carbon put forward. J. G. H.

635. Lubricants for oil engines. J. S. Paten and A. V. Driver. *Gas Oil Pwr*, 1955, **50**, 339.—The visc of an oil determines its use in engines in respect of temp of cyl, size of cyl, gas pressure in cyl. For bearings a continuous oil film should be maintained between the parts, and hence worn bearings may require oil of higher visc than normal. In circulating systems the oils must be resistant to oxidn, for bearing metals are readily attacked by acids derived from oil oxidn at temp near 250° C.

Specifications for oils for various levels of performance are outlined. In general, the standard tests as laid down are insufficient to evaluate the oil completely, and specific performance tests, *e.g.* for ring sticking, piston cleanliness, oil-ring blocking, sea-water corrosion, cyl lacquer, and wear have been devised. H. C. E.

BITUMEN, ASPHALT, AND TAR

636. New asphalt classification system. L. W. Corbett. *Petrol. Process.*, 1955, **10** (12), 1896–8.—A simple system is described for the classification of asphalts based on division of all petroleum asphalts into 2 groups according to ultimate use: paving asphalts and industrial asphalts. Paving asphalts are those of all consistencies used for roads, airports, and other traffic bearing surfaces. Industrial asphalts are asphalts of all consistencies used directly or in compounded form in industrial products and construction products not included in the paving group. J. H.

DERIVED CHEMICAL PRODUCTS

637. Oxygenated petrochemicals. Pt IV. P. W. Sherwood. *Petrol. Engr*, 1955, **27** (13), C14–18.—Partial oxidn of hydrocarbons is the direct route to oxygenated petrochemicals, but control of the oxidn reaction and separation of the complex product mixture pose formidable engineering problems. Important applications are the oxidn of propane–butane mixtures, ethylene to ethylene glycol, and acrolein production. The production of monohydric alcohols by direct hydration of lower olefins and hydrolysis and saponification are also considered, as is the liq phase synthesis of monohydric alcohols. J. B. S.

638. Petroleum chemical developments in Western Europe. C. F. M. Mackintosh and H. Steiner. *Petrol. Times*, 6.1.56, **60** (1524), 27.—This final section in a series of 3 articles discusses some of the major developments in the European chemical industry during 1955. G. A. C.

CORROSION

639. Corrosion and cathodic protection in Kuwait. J. S. Gerrard. *J. Instn Elect. Engrs*, 1956, **2**, 2–6.—Measures taken to protect the oil installations in Kuwait are described. A new type of corrosion has been established which is due to the proliferation of cellulose-decomposing bacteria on moist paper servings in contact with the lead sheath. The end products of the decomposition include carbon dioxide, which, acting on the lead, produces lead carbonate.

(Taken from E.R.A. Abstracts.)

640. Lining that can save a leaking tank. Anon. *Nat. Petrol. News*, 1956, **48** (1), 99.—A U.S. lime-based material is claimed to plug leaks in 275-gal home heating oil storage tanks. The product has been used in *ca* 4000 tanks in New England, and costs *ca* ¾ of a conventional plugging job. M. P. T.

641. Corrosion control in oil and gas producing equipment. J. L. Gattenmeyer, F. H. Hewes, and W. H. Seager. *Canad. Min. metall. Bull.*, 1956, **49** (525), 31–6.—Due to the relative youth of most W. Canadian producing oil and gas fields, corrosion losses have, to date, been relatively minor. It is anticipated, however, that in future corrosion costs will be of serious magnitude.

Thus, the paper shows where corrosion can occur in the various types of equipment; gives examples of corrosion failures in the Alberta fields; discusses briefly the mechanism of such corrosion; outlines and describes the 6 general method s of corrosion prevention; gives some examples of how these methods may be applied to the solution of oilfield corrosion problems; and outlines a logical step-wise procedure for the detection and economical mitigation of corrosion. 8 figs. M. P. T.

642. Latex-cement compositions in corrosion-resistant construction. Pt 1. P. B. Cormac. *Corrosion Tech.*, 1956, **3**, 43–6.—The advantages of latex-cement compositions in combating the ravages of corrosive attack are summarized as follows: (1) high bond strength to practically all surfaces, even when wet, including dense unkeyed ceramic units; (2) resiliency and elasticity, resulting in resistance to thermal shock and structural movements; (3) high tensile strength; (4) permanent water impermeability; (5) considerable resistance to attrition; and (6) resistant to attack by weak acids and alkalis.

One object of this short survey is therefore to show how these somewhat unique characteristics can immunize plant and structures from chemical attack. 2 figs. M. P. T.

ENGINES AND AUTOMOTIVE EQUIPMENT

643. 1956 cars: a final look. H. Ridder. *Nat. Petrol. News*, 1956, **48** (2), 107.—This summary of U.S. car specifications illustrates the trends which are taking place in C.R., octane requirements, gasoline tanks, and fuel filters. It also includes notes on lubrication and chassis and bodywork features. M. P. T.

MISCELLANEOUS

644. Record increase in world production. Anon. *Petrol. Press Serv.*, 1956, **23**, 2–5.—The year just ended witnessed the largest increase in oil production so far recorded since the beginning of the industry. The world's crude oil output rose by 77 million metric tons, reaching a total for the year of 763 million metric tons. Hitherto, the biggest increase—65 million tons—had occurred in 1951. Last year's rate of expansion was unexpectedly high. As indicated a year ago, it was expected that the rise in 1955 would be rather more than the rise achieved in 1954 (*ca* 30 million tons), but the extent of the rise in demand and in production in the U.S.A. was unforeseen. Over the past 3 decades, crude oil production in the free world has advanced at an annual average rate of *ca* 5½%, but last year's increase was equivalent to over 10%.

(Author's abstract.)

645. Price of crude oil. G. Lugol. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1295–307.—Among major producers direct influence of cost price on selling price is mainly applicable only in the U.S.A., as elsewhere, *e.g.* Middle East, extraneous (*e.g.* political) factors complicate the picture. Make-up of cost price in the U.S.A. is examined in some detail, tabulated breakdown of such costs over last 20 years indicates average 18% excess of sale over cost price. Each unit of crude produced requires that 1½ units be discovered to maintain ratio proven reserves-annual consumption. Main cost is exploration and development, return on which has to be awaited some years, average U.S.A. interval being 7–8 years. Yield on investment in petroleum exploration, corrected for changing value of money and after tax deduction, is 9–10%. Cost price in Germany, Canada, and France is also briefly examined.

V. B.

646. Revived refinery expansion. Anon. *Petrol. Press Serv.*, 1956, **23**, 42–4.—With the continuous increase in the free crude oil production there is a continuous need for new oil refining capacity whether by the creation of new plants or the extension of those already in existence. Thus, investment in refinery plant during the next few years is likely to be very substantial.

The paper gives details of refinery expansion in the free world during the past few years. 3 tables. M. P. T.

647. Automation and its impact. Anon. *Petrol. Press Serv.*, 1956, **23**, 50–3.—The news that the Russians are to set up a Ministry for Automation is illustrative of the attention now being devoted in industrialized countries to the new techniques of automatic control. In this field the oil industry was one of the pioneers. The article explains what automation involves, cites examples of its application in petroleum production and refining, and suggests some likely social and economic implications of its wider adoption.

(Author's abstract.)

648. The production of chemicals from coal and petroleum. P. H. Given. *BCURA Bull.*, 1955, **19**, 589–606.—This survey is largely confined to organic chemicals and their production from coal and petroleum. Attention has been paid almost exclusively to actual production figures, but only those products manufactured in large quantity by the chemical industry from the by-products of fuel processing are considered. Thus, plastics and fibres; plasticizers; synthetic rubber; detergents; automotive and aviation chemicals; insecticides and weed killers; dyestuffs, lakes, and toners; medicinal products: and solvents are considered in detail, and evidence is given of the sharp rise in production of nearly all these products since 1948.

The raw materials from which these products are made and the increasing attention which is being paid to the production of smokeless fuels in the U.K. are also considered. A NCB process, which involves low-temp carbonization of powdered coal fluidized in a stream of oxygen-containing gas, gives high yields of a tar particularly rich in many of the chemical raw materials most in demand. If this or similar processes prove successful on a large scale, they may make a significant contribution to tar resources in a few years time.

In view of the scale of refinery operations at the present time, quite minor proportions of throughput taken off as by-products are sufficient to meet very large demands from the chemical industry. It is therefore concluded that the petroleum industry should have no difficulty in meeting the increasing demands of the chemical industry.

The paper also includes notes on the uses and sources of some individual chemicals, namely ethylene; benzene and its homologues; ethanol; acetylene; phenol; styrene; phthalic anhydride; propene; methanol; acetic acid and anhydride; butenes; and chlorinated hydrocarbons.

Finally, the economics of new processes are considered. 14 tables, 45 refs. M. P. T.

649. Survey of British fuel research. Pt 1. Anon. *Petroleum, Lond.*, 1955, **18** (10), 368.—Research has been continued on the Fischer–Tropsch synthesis into the development of cat which combine satisfactory activity and selectivity with low cost, and in establishing the effect of temp, pressure, and gas composition on yield and life of cat. Reaction mechanism has been studied from product composition and by radioactive tracers. Pore structure of cat has been investigated, and a relationship between adsorption and desorption isotherms derived from thermodynamic considerations.

J. B. S.

650. Development of chemical utilization of fuels in Italy. C. Padovani. *BrennstChemie*, 1956, **37** (1–2), 1–9.—Italy's economic position regarding raw materials in the power field is reviewed. Processes for chem utilization of imported solid and liq fuels are discussed. Replacement of coal gas with natural and refinery gases as raw materials is progressing.

R. T.

651. Italy's new petroleum bill. Anon. *Petrol. Times*, 6.1.56, **60** (1524), 5.—Petroleum legislation in force under the Sicilian Regional Government is compared with the recently published draft bill, which, if it becomes law, will govern oil prospecting and oil development on the mainland of Italy.

G. A. C.

652. Tapping the energy sources. M. L. Kastens. *Chem. Engng*, 1955, **62** (11), 201.—Several authorities are quoted to show the trend of U.S. energy requirements, and the need for new energy sources on economic grounds is discussed. Several possible sources are mentioned, and the need for a new chemical technology to develop and apply new forms of energy is stressed. Particular emphasis is laid on energy storage problems for such forms as solar energy. D. J. S.

653. Non-aqueous cement process. J. C. Witt. *Chem. Engng*, 1955, **62** (11), 207.—A new process for the manufacture of Portland cement is summarized, and a flow sheet given; a considerable heat economy was effected by ex-

amining the heat required for each part of the process, and savings of several cents/brl in manufacturing costs are forecast. D. J. S.

654. Why nitrogen keeps booming. R. P. Windisch. *Chem. Engng*, 1955, **62** (11), 280.—The need for increased fertilizer production in order to replace lost nitrogen is discussed in an article on the economics of nitrogen. 24% of U.S. production is used industrially, and the various products and industries are listed. D. J. S.

655. Inventory issue of *Chemical Engineering*. Various. *Chem. Engng*, Oct. 1955, **62** (13).—The annual issue publishes brief notices of developments over the past year in plants and utilities, processes and technology, chemicals and materials, equipment and accessories, and technical literature. It is cross-indexed. D. J. S.

656. The combustion of solid fuels and the aims of flame radiation research in relation to the burning of pulverized coal. D. T. A. Townend. *J. Inst. Fuel*, Dec. 1955, **28** (179), 609, 625.—Address delivered at the inauguration of the pulverized-fuel plant to the International Flame Research Foundation, Ijmuiden, Holland, 12 Nov. 1955. Aspects considered in the speech are: forms of fuel–air systems, known chemical reactions during the combustion of solid fuel, rate-determining process of solid fuel combustion, research work specific to pulverized-fuel combustion, oil and gas firing, and pulverized fuel firing.

A short description of the inauguration is given, and also abridged reports of the speech of welcome by A. H. Ingen Housz, and speeches by Prof. G. M. Ribaud and L. Daum. A brief account of the outstanding features of the plant is included. D. K.

657. The old year 1955. Anon. *Petrol. Times*, 6.1.56, **60** (1524), 15.—A general review of the year's highlights is given, including oil legislation, exploration and its results, world production of crude oil, refining and refinery capacity, atoms and oil, petroleum consumption in the free world, and oil in international trade. G. A. C.

658. World-wide oil report. P. Swain and R. Gibson. *Oil Gas J.*, 26.12.55, **54** (34), 41.—The review, which gives reserves, wells, production, and refining by countries, shows an increase of 11·8% on total world production over 1954 and an increase of 4·2% on world refining capacity. Growth is faster abroad than in the U.S.A. G. A. C.

659. Western Europe's petrochemical program has three prime targets. Anon. *Oil Gas J.*, 26.12.55, **54** (34), 231.—A review is given of French, German, Italian, Belgian, and British petrochemical activities, which are designed to replace imports from the dollar area, substitute raw materials formerly obtained by more expensive techniques, and augment existing range of chemicals and raw materials. G. A. C.

BOOK REVIEW

Gas Turbines and Jet Propulsion. 6th Edition. G. Geoffrey Smith. London: Iliffe and Sons Ltd, 1955. Pp. 412 + xx. 35*s*.

Following the death of the author in 1951, F. C. Sheffield has undertaken further revision of this pioneer exposition of the principles and practice of the aviation gas turbine. The book was first launched in 1942, as a small volume, commensurate possibly with the progress of the new engine. The current edition reflects the rapid advance since that time and, in 412 pages, now covers a wide variety of subjects and applications. The treatment on a quantitative basis allows 35 pages to the historical aspect, 150 to fundamental and detail aspects, and the remainder to applications. In style the treatment is journalistic rather than technical, but good and often incisive journalism. The results of complicated performance calculations are often better expressed in words than in formulæ, and the book is eminently readable as a result. Liberal use is made of illustrations, many of which are the elegant cut-away drawings from *Flight*. I. G. B.

ADDITIONS TO THE LIBRARY

Twentieth Century Petroleum Statistics 1955. DeGolyer and MacNaughton. Dallas, Texas: DeGolyer and MacNaughton, 1955. Pp. 87 + ix, 87 charts. $7.50.

This eleventh edition of "Twentieth Century Petroleum Statistics," which was prepared initially by the Office of the Directors of Naval Petroleum and Oil Shale Reserves and in 1945 by the authors, contains detailed statistics relating to the petroleum and natural gas industry.

The statistics relate mainly to the U.S.A., and cover the period 1918–54. World figures for crude oil production by individual countries are also given, and in every case the statistical table is accompanied by a chart which clearly shows the trend over the period concerned. In regard to the U.S.A. no statistic seems to have been omitted. For example, there are figures on posted prices of crude oil, reserves of natural gas, consumption *per capita*, average life of wells, drilling details, and estimates of reserves. World reserves are also estimated.

Natural Gas Statistics. R. C. Henshaw, Jr. Austin, Texas: Bureau of Business Research, University of Texas, 1955. Pp. 127. $2.

This publication, which supplements "Economics of Natural Gas in Texas" published in 1952, brings statistical and other material up-to-date to 1953. The statistics cover the production, consumption, and utilization of natural gas in the U.S.A., and the 87 tables provide a source of considerable information regarding natural gas and natural gas liquid. Supplementing the tables are 38 charts indicating trends over a period of years and a number of figures showing the location of natural gas areas, pipelines, etc.

The Junior Institution of Engineers. Journal and Record of Transactions. Vol. LXV, 1954–55. London: The Institution, 1955. Pp. viii + 396 + 12.

Review of Benzole Technology 1954. London: The National Benzole Association, 1955. Pp. 108. 21*s*. 6*d*., post free.

This 1954 edition of The National Benzole Association's annual Review of Benzole Technology follows the general layout of its many predecessors. Each of its 12 chapters discusses some particular aspect of the main subject, the chapter headings being: Production from Carbonization Processes; Benzole Recovery; Production of Aromatic Hydrocarbons from Other Sources; Composition; Benzole Refining; Properties of the Constituents of Benzole; Uses of Benzene Other than as a Motor Fuel; Motor Fuels and Internal Combustion Engines; Analytical Methods;

Specifications; Safety and Handling; Economics and Statistics.

References to published literature used in the preparation of the Review number 865, and an appendix covers the accessions of the Technical Library held by the National Benzole Company at Watford.

1955 Book of ASTM Standards (including Tentatives). Pt 4. Paint, Naval Stores, Cellulose, Wax Polishes, Wood, Acoustical Materials, Sandwich and Building Constructions, Fire Tests. Philadelphia: American Society for Testing Materials, 1955.

British Standards:

B.S. 759 : 1955. Valves, Gauges and other Safety Fittings for Application to Land Boilers and to Piping Installations for and in Connection with Land Boilers. Pp. 27. 4*s*. net, post free.

B.S. 1306 : 1955, Pt I. Non-ferrous Pipes and Piping Installations for and in Connection with Land Boilers. Pp. 16. 3*s*. net, post free.

B.S. 2648 : 1955. British Standard Performance Requirements for Electrically-heated Laboratory Drying Ovens. Pp. 12. 2*s*. 6*d*. net, post free.

B.S. 2655 : 1955, Pt 3. Electric Lifts. Part 3. Outline Dimensions. Pp. 17. 3*s*. net, post free.

B.S. 2688 : 1955. Dimensions of Impulse Magnetos (Unscreened and Screened). Pp. 27. 5*s*. net, post free.

B.S. 1553 : 1956, Pt 4. Graphical Symbols for Heating and Ventilating Installations. Pp. 18. 3*s*. 6*d*. net, post free.

B.S. 2633 : 1956. Pp. 70. 10*s*. post free.

This standard covers shop and site metal-welding of joints in steel pipe and pipe assemblies up to and including 24 inches diameter. Standards of workmanship and the standards to which the welds usually conform are also given, and the standard covers metal-arc welding with or without a backing ring or with an oxy-acetylene base run.

B.S. 2647 : 1956. Welded Steam-heated Jacketed Pans for Processing Industries (excluding Catering Equipment). Pp. 10. 2*s*. 6*d*. net, post free.

B.S. 2656 : 1956. Zinc Anodes, Zinc Cyanide and Zinc Oxide for Electroplating. Pp. 26. 4*s*. net, post free.

B.S. 2657 : 1956. Fluoroboric Acid and Metallic Fluoroborates for Electroplating. Pp. 23. 4*s*. net, post free.

B.S. 2693 : 1956. Screwed Studs. Pt 1. General Purpose Studs. Pp. 17. 3*s*. 6*d*. net, post free.

B.S. 2697 : 1956. Rack Type Gear Cutters. Pp. 14. 2*s*. 6*d*. net, post free.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

660. Exploration for oil and gas and correlation of horizons on the basis of chemical composition of gases dissolved in waters. J. Janak. *Nafta (Krakow)*, 1954, **10**, 225–7.—So far waters have been analysed for mineral contents and occasionally for CO_2, H_2S, and hydrocarbons. Chromatography has made the gas analysis easier. Neutral gases are boiled off and carried by a stream of CO_2 over an absorbent. They are retained in order of their mol. wt. 2 ratios are then worked out: (1) hydrocarbons : nitrogen; and (2) hydrocarbons heavier than methane : methane. The results can be plotted over a geological map of the area or along the line representing the depth of a well. M. S.

661. Southeast New Mexico's oil potential. R. F. Montgomery. *Oil Gas J.*, 2.1.56, **54** (38), 145.—There is active exploration in SE. New Mexico, where there have been a number of recent discoveries and extensions; the oil prospects and geology of this area, which lies within the Permian basin, are outlined.

Most of the production comes from the Permian, but Devonian, Silurian, and Ordovician are becoming more important. The area includes the Artesian Vacuum trend N. of the Delaware basin, the NW. shelf fields N. of this trend, and the N. Central basin platform fields, which include Hobbs, where recovery is over 13,000 brl/acre. C. A. F.

662. San Juan basin fulfils its promise. F. C. Barnes. *Oil Gas J.*, 6.2.56, **54** (40), 154.—The geology and oil possibilities of the San Juan basin, New Mexico, are briefly described. Oil was first found in 1911, and development has been irregular due to erratic discoveries and poor communications; it is now the main gas producing area of the Rocky Mountain Province. By Dec. 1955 oil and gas had been produced from the Mississippian, Pennsylvanian, Jurassic, U. Cretaceous, and Tertiary in fold and fault structures and stratigraphic traps; the latter traps hold the largest reserves and have the main production. Future possibilities include deep pays below the U. Cretaceous. C. A. F.

663. Texota test hits. Anon. *Oil Gas J.*, 9.1.56, **54** (36), 63.—1 Sarah Swenson, a wildcat in the Williston basin near the Canadian border, on test produced 310 ft of 32° oil from Upper Mission Canyon at 6206–6241 ft. The discovery is to the N. of the fields along the Nesson anticline. C. A. F.

664. Why North Madill is so perplexing. N. S. Morrisey. *Oil Gas J.*, 23.1.56, **54** (38), 134.—The geology and development of the N. Madill field in S. Oklahoma are described. The field is in the S. flank of the Arbuckle Mts, and there are 5 Simpson pay sands ranging from 30 to over 100 ft at *ca* 6200 ft. The geology is complex and normal and reverse faults have been penetrated by wells; accumulations appear to be controlled by faulting. In the main fault block the oil is trapped in a closure against a major fault zone with beds dipping NE.

A cross-section showing an interpretation of the structure is included. C. A. F.

665. Developing California's Tejon–Grapevine field. J. P. Lavery, Jr. *Oil Gas J.*, 16.1.56, **54** (37), 152.—The development of the Tejon–Grapevine field in SE. San Joaquin Valley, California, is described; there are 3 areas of production. In the E. and W. areas most of the production comes from Upper Miocene Transition zone sands, and in the central area there are 6 main pays: Transition, Santa Margarita, Pulv., Valv., Olcese, and JV sands.

Below the JV there is a basalt series 1400–1800 ft thick and overlying unexplored sediments of Eocene and Jurassic age; these are productive in nearby areas. C. A. F.

666. Cal-Standard strike extends Pembina. Anon. *Oil Gas J.*, 30.1.56, **54** (39), 119.—The Pembina field in Alberta has been extended a further 3½ miles to the NW. by 4–25 NE. Cynthia, which found production in the Cardium sand at *ca* 5800 ft. Total depth was 7010 ft. A N. extension to the area has been limited by 6 dry holes on the Cynthia tract N. of the Texaco lease. A sketch map showing the indicated limits of the Pembina–Cardium pay is included. C. A. F.

667. Jamaican venture near. Anon. *Oil Gas J.*, 9.1.56, **54** (36), 74.—Further exploration in Jamaica is planned, and geological and geophysical surveys will be made. A well drilled last year near Negril, Base Metals 1, in W. Jamaica reached 6300 ft, finding a strong gas show at 760 ft and shows of heavy oil and salt water at several depths. Eocene beds were present to 5800 ft. C. A. F.

668. New shows in Cuba. Anon. *Oil Gas J.*, 16.1.56, **54** (37), 89.—1 Cristales, a wildcat 5 miles NE. of Majagua in central Cuba, has found shows from levels above 5000 ft, of which the top 2 at 3200 and 3800 ft were thought non-commercial. The well is in the central basin and is the second test in the area, the first being abandoned in serpentine at 5280 ft.
C. A. F.

669. Belayim extended. Anon. *Oil Gas J.*, 16.1.56, **54** (37), 88.—A wildcat in the Sinai peninsula, Egypt, has extended the S. productive limit of the Belayim field by 3½ miles; on test the well flowed 55 brl of 22° oil from Lower Miocene sand at *ca* 8000 ft. C. A. F.

670. A review of the field investigations carried out by the Geological Survey of India during the field season, 1954–5. The Director, Geological Survey of India. *Indian Minerals*, 1955, **9**, 229–40.—As a result of the Government of India's proposals to intensify the search for oil by geological and geophysical methods and, where necessary, by exploratory drilling in the prospective areas of the country, the Geological Survey decided as a first step to confine such work to approx 4000–5000 sq. miles in Jaisalmer, eventually extending to the neighbouring areas covering more than 25,000 sq. miles.

The work will be in 3 phases: (1) aero-magnetic and ground surveys; (2) geophysical methods and detailed geological mapping of the rock formations exposed in parts of the area; and (3) test drilling.

Pending confirmation of the Government's proposals, a geophysical party was sent to Jaisalmer to start preliminary work, and over 240 field investigations have been made. The paper gives an account of these investigations. M. P. T.

671. Australia still looking for second field. W. D. Mott. *Oil Gas J.*, 16.1.56, **54** (37), 95.—Current exploration in Australia is outlined, and the geology of the favourable areas is briefly described. During 1954 and up to Sept. 1955, *ca* 33 wells were drilled, of which only 2 were producers (one gas and one oil); traces were found in other wells.

There are at least 10 sedimentary basins in Australia, and there are also possibilities in Papua, which has potential reservoir rocks and structures. A survey of wells drilled in each of these areas during 1954 and to Sept. 1955 is given; the areas are Papua–New Guinea, Fitzroy and Canning basins, Carnarvon basin, Gippsland basin, Sydney basin, Maryborough basin, Bowen Syncline, and the Great Artesian basin. C. A. F.

672. D'Arcy continues 20-year search in British Isles. Anon. *Oil Gas J.*, 6.2.56, **54** (40), 77.—A field has been found at Egmanton in the E. Midlands *ca* 6 miles from the Eakring field, Nottingham. The discovery produced *ca* 40 b.d. from *ca* 3500 ft, and 2 further producers have been completed.

At Plungar field, Leicester, discovered in 1953, there are 4 wells producing *ca* 150 b.d.

There are now 7 small oilfields in the U.K., mainly in the Nottingham area, producing *ca* 1200 b.d. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

673. Present-day state of geochemical prospecting of oil formations in U.S.S.R. J. J. Glogoczowski. *Nafta* (*Krakow*), 1954, **10**, 211–13.—In 1929 so-called "gas contours" were first taken by V. A. Sokolov. The later development of this method is known as soil analysis. Whilst the first efforts aimed at finding hydrocarbons in the soil, the present-day work concerns itself with mutual action of the gases on soil and vice versa, as well as on micro-organisms which help such action. Certain ideas now discarded are described, together with most up-to-date methods. The importance of nitrous oxide and carbon monoxide is now given less weight, and various methods of analysis must point to presence of gas or oil in substratum before any faith is placed in such indications. Tests in localities of known structure are still used to provide data. M. S.

DRILLING

674. New sealer for lost-circulation zones. F. B. Odasz and M. F. Westfall. *Oil Gas J.*, 23.1.56, **54** (38), 72.—The use of asphalt to combat lost circulation is outlined; the technique involves pumping hot asphalt into the well at 3–10 times the volume of the well bore, allowing it to cool, and then drilling out the asphalt plug. Special asphalt has been manufactured for the purpose, and it is claimed that the method has been effective in severe cases of lost circulation. C. A. F.

675. Where to drill with air. Pt 1. E. McGhee. *Oil Gas J.*, 9.1.56, **54** (36), 91.—Application of air drilling in the Permian basin of W. Texas is described. Faster drilling is possible, but no effective method of shutting off water has yet been found; rigging-up is also costly. Air drilling is of most value where there is a long section of hole free of water.

Various problems encountered in air drilling are outlined, and summaries of operations in the Permian basin are given.
C. A. F.

676. How to use air drilling successfully. M. M. Brantly. *Oil Gas J.*, 9.1.56, **54** (36), 93.—Air drilling was introduced primarily to combat lost circulation, but it has been found that there is a generally higher penetration rate than in mud drilling, and bit life is longer.

The air temp must be as low as possible except when drying the hole, particularly when drilling through a pay zone. Recent operations in N. Mexico have indicated that water flows may be overcome by increasing the volume of air circulated after penetrating water zones.

Other aspects of air drilling, such as sampling, coring, and completion methods, are outlined briefly. C. A. F.

677. Air–gas drilling is faster and cheaper. F. R. Nelson and N. S. Morrissey. *Oil Gas J.*, 16.1.56, **54** (37), 99.—Problems and results of drilling with air or gas instead of mud in the Rocky Mountain area are described. It is claimed that drilling costs can be reduced 75% under favourable conditions; there are soft formations which can be drilled easily, and beds which do not cave or produce excessive water.

Bit performance showed an improvement of 4–8 times that on fluid drilled holes, and under proper conditions all normal drilling operations, fishing, coring, etc., can be carried out using air or gas under pressure. C. A. F.

678. Forging of percussion drilling bits in oilfield smithy. J. Tyczynski. *Nafta (Krakow)*, 1954, **10**, 243.—Instructions given. M. S.

679. Naphthenic drilling mud. S. Gierlaszczynska and J. Gumulczynski. *Bull. Polish Inst. Petrol.*, 1954, **4**, 9–10 (Suppl. to *Nafta (Krakow)*, 1954, **10**).—Following Rumanian example Na soaps of naphthenic and sulphonic acids were tried by Polish IP lab. Their addition to mud has resulted in low filtration and low gravity. Slight increase in visc was countered by further dilution or addition of 0·01% of pyrophosphates. Other properties were unchanged. Concn of pure soap in mud was 0·07–0·28%. This must be first dissolved in hot water. Any frothing can be counteracted by addition of kerosine. Ca and Ba coagulate these muds. M. S.

680. Science and technique in Soviet Union—hydraulic shooting of oil-bearing formations. G. K. Maximovich and B. Fleszar. *Nafta (Krakow)*, 1954, **10**, 237–42.—Acidizing or use of explosives for shooting has only a local effect. A single crack increases the permeability of the formation out of all proportion. Fluid, carrying coarse sand, bursts the formation, the grains of sand settle and keep the new cracks open. Author works out the necessary formulæ for pressure of mud required. This ought to be approx double the hydrostatic pressure at the bottom of the well. Choice of liq and its properties are explained. Details of formation of cracks and the procedure and equipment are given. After the operation the hole must be examined and completed. M. S.

681. (Portable) Soviet drilling rigs on lorry chassis. R. Wolkowicz. *Nafta (Krakow)*, 1954, **10**, 227–30.—5 rigs ranging from 1¾ to 4½ inches for drilling to a max depth of 50–800 m respectively are described in fair detail. M. S.

682. What mud particles do to your pay. R. F. Kreuger and L. C. Vogel. *Oil Gas J.*, 6.2.56, **54** (40), 111.—The effective permeability of sand to oil can be permanently impaired by the penetration of mud particles during drilling; tests carried out on cores exposed to different muds under conditions simulating drilling have shown that the depths of penetration of mud particles have varied from 2 to 12 inches after 5 days' exposure, depending on the type of mud used.

The test procedure is described in detail, and charts showing the results are included. C. A. F.

683. Fatkuliev's drilling method. Anon. *Nafta (Krakow)*, 1954, **10**, 215–16.—Gravity of mud should be kept as low as possible, since high gravity and high visc often lead to occlusion of formation gases, even if these are at low pressure. Disruptive properties of low gravity mud on some rocks is countered by high speed of drilling. For this work the crews must be specially experienced, and high gravity mud must be kept in reserve. M. S.

684. Deep-salt headaches in East Texas. C. P. Lawhon and J. P. Simpson. *Oil Gas J.*, 6.2.56, **54** (40), 114.—Drilling problems due to salt movement in the borehole in the E. Texas area are discussed; salt movement during drilling is believed to be due to flowing of salt under the temp and pressure conditions existing at depth which causes sticking pipe and bits. After experimental work a drilling procedure to combat the problem has been worked out, and this is described. Another possible solution is the use of high-density low filtrate–low salt muds. 2 refs. C. A. F.

685. How world's deepest well was drilled. E. McGhee. *Oil Gas J.*, 23.1.56, **54** (38), 82.—Methods and equipment used in drilling 1 L Humble—L. L. and E—State Lease 2414, the world's deepest well, are described. The well is 35 miles S. of New Orleans and has been drilled to 22,570 ft in Miocene at a total cost of *ca* $2,000,000. Drilling was carried out from a barge. C. A. F.

686. Centrifuge cuts mud costs. E. McGhee. *Oil Gas J.*, 6.2.56, **54** (40), 106.—A drilling-mud centrifuge has been tested in 4 development wells in the Rayne field, Louisiana, in order to evaluate the saving in cost by visc control of the mud. On the well, 2 T Petitjean, with a mud weighing approx 12 lb/gal, there was a net saving of $7200 (or $1.89/ft) between 9200 and 13,000 ft. On 2 other wells visc control of muds of 15·7–16·3 lb/gal showed an average net saving of $1.42/ft.

Details of the test procedures are given, including costs and amounts of materials. C. A. F.

687. Scientific and technical meeting at Stalinogrod. J. Wojnar. *Nafta (Krakow)*, 1954, **10**, 192–3.—Recommends drilling deeper in the Carpathians using electrical logging, also drilling in central and N. Poland. Smelting and Mining Academy is recommended to broaden its educational plans. M. S.

688. Drilling progress 22·2 metres per hour during well drilling in U.S.S.R. Anon. *Nafta (Krakow)*, 1954, **10**, 217.—Details of work at Tooymahzaboornyeft in 1953. M. S.

689. Drilling analysis as a way to obtain the best results in the light of U.S.S.R. experience. K. Mischke. *Nafta (Krakow)*, 1954, **10**, 202–6.—Such analysis must be based on statistics collected on the spot, and such work was done by Prof Shatsov and published in the U.S.S.R. in 1950. 5463 drillings were considered, all in Devonian deposits in Second Baku. Progress was analysed in detail. 9⅞-inch size bit is proved to be more economical than 11¾-inch. Graphical representation of progress *v.* mud flow and pressure on the bit helps those interested to reach optimal conditions. M. S.

PRODUCTION

690. Sharon Ridge operators unitize, start water injection, to double oil production. T. M. Ocheltree. *Oil Gas J.*, 16.1.56, **54** (37), 91.—Oil recovery from the reef fields of Scurry County is high, but engineering studies have shown that this can be increased by water injection and pressure maintenance; for this reason Sharon Ridge field in SW. Scurry County has recently been unitized and water injection has been started. The geology and secondary recovery operations and plant are described, and it is claimed that the project will recover an estimated 115% more oil from the Canyon reef than would be obtained naturally.

Ultimate injection of 75,000 b.d. is planned at a pressure of 3000 p.s.i. The reservoir is at *ca* 6800 ft. C. A. F.

691. Gas lift produces a solution-gas reservoir efficiently. E. McGhee. *Oil Gas J.*, 23.1.56, **54** (38), 62.—Gas-lift operations in the W. Saratoga field, Hardin County, Texas, are briefly described. The reservoir has a solution-gas drive, and early wells flowed oil; because of the danger of gas-locking in beam pumps a gas-lift system was installed for the post-flow phase. C. A. F.

692. Production costs—the central problem of economy. W. Swidrak. *Nafta (Krakow)*, 1954, **10**, 222.—Recent conference disclosed that only 43% of the working time was really utilized for drilling. All efforts are being made to bring the cost/m drilled and cost/ton produced to within estimated expenses by appealing to the crews, and recently a 3000-m well has been drilled without a single stoppage due to mishap. In Krosno area results are discouraging. M. S.

693. Some axial-symmetrical problems of non-steady filtration of liquid and gas in a porous medium. G. I. Barenblatt and N. P. Trifonov. *Izvest. Akad. Nauk SSSR., Otdel. Tekh. Nauk*, 1956, (1), 59–70.

694. Electric heaters for continuous dewaxing of boreholes. J. Ostaszewski. *Bull. Polish Inst. Petrol.*, 1954, **4**, 10 (Suppl. to *Nafta (Krakow)*, 1954, **10**).—Heater described, with diagram, raised production by 10%. M. S.

695. Methods of preparation and results of flooding boreholes in Soviet oilfields. W. Kulczycki. *Nafta (Krakow)*, 1954, **10**, 206–11.—This matter was discussed during conference held

in U.S.S.R. in April 1953. Results obtained during 1947–53 show that in 50% of the cases preparations were very simple indeed. The other half were costly and often ineffective. The first were mostly in limestone, the latter in sandstone. Good knowledge of rocks is essential. Details of completion, shooting, "acidizing," draining, hydraulic breaking-up, reinforcing, washing, and hot water treatment are given, followed by detailed instructions. M. S.

OILFIELD DEVELOPMENT

696. Free world production jumps 11 per cent. P. Swain. *Oil Gas J.*, 30.1.56, **54** (30), 186.—Total free world production in 1955 was 11% higher than in 1954, with the biggest increase of 18·2% in the Middle East. Reserves for 1955 are estimated at 22·5% above the 1954 figure, with the greatest increase again from the Middle East. A table shows world oil production and reserves by countries, totalled for areas. C. A. F.

697. Industry completes 12,271 wildcats in 1955. J. C. McCaslin. *Oil Gas J.*, 30.1.56, **54** (39), 142.—12,271 wildcats were completed in the U.S.A. in 1955, with an average depth of 4804 ft compared to 4831 ft in 1954. Greatest footage drilled was in Texas: 25,577,357 ft. Of the total wildcats drilled, 1812 were completed as oil wells, compared to 1598 in 1954.

Tables show U.S.A. wildcat completion by years since 1945, the ratio of wildcat wells to total wells since 1950, and wildcat completions by states and total footage for 1955. C. A. F.

698. Depth records are broken in 16 areas. J. C. McCaslin. *Oil Gas J.*, 30.1.56, **54** (39), 147.—Production depth and drilling depth records in the U.S.A. are reviewed and tabulated. The world's deepest producing area is at Weeks Island field in S. Louisiana, where several wells are producing from Miocene below 17,500 ft. C. A. F.

699. Williston basin swings into action. J. C. McCaslin. *Oil Gas J.*, 30.1.56, **54** (39), 344.—7 new fields and extensions were discovered in the Williston basin of N. Dakota in 1955, and recent wells have promised further new fields and extensions. There are indications that Beaver Lodge and Hofflund fields may be continuous.

Fields discovered in 1955 were Newbury (Trias–Spearfish), Bluell (Mississippian–Charles), Coteau (Charles), Blue Buttes (Madison), North Souris (Mississippian Mission Canyon), Blue Buttes extension (Madison), and Hofflund extension (Madison). C. A. F.

700. Western Canada looks confidently ahead. Anon. *Oil Gas J.*, 16.1.56, **54** (37), 156.—Proved oil and gas reserves in W. Canada increased during 1955, and oil potential (M.E.R.) at the end of the year was estimated at 695,000 b.d., *ca* 25% higher than a year before. Proved reserves at the end of 1955 were estimated at 3¼ billion brl oil and *ca* 22 trillion cu. ft. gas.

158 new fields were found, compared with 182 in 1954, and 2879 wells were completed, as against 2201 in 1954. 98 of the discoveries were in Alberta, and 41 in Saskatchewan.

New records were expected in 1956, and further exploration in the foothills area and development of the Mississippian production in the Sundre–Harmatton and Westward Ho areas are anticipated. C. A. F.

701. Thirteen firms to start Libyan search. Anon. *Oil Gas J.*, 16.1.56, **54** (37), 87.—Over 91 million acres of concessions have recently been granted by the Libyan Government, and exploration plans include a test well early in 1956. Geological and geophysical work have been carried out during the last 2 years by one company. C. A. F.

702. Kuwait looks offshore. Anon. *Oil Gas J.*, 6.2.56, **54** (40), 76.—Plans are being made to offer concessions offshore from Kuwait and the neighbouring Neutral Zone.

Production in Kuwait in 1955 averaged 1,092,600 b.d., 14·7% higher than in 1954. There are *ca* 175 flowing wells in the state, comprising 133 at Burgan and *ca* 42 at Magwa-Ahmadi. The recent Raudhatain discovery in N. Kuwait may prove to be the most prolific producer in the Middle East. C. A. F.

703. Parentis picks up. Anon. *Oil Gas J.*, 30.1.56, **54** (39), 136.—Production from Parentis field in SW. France is *ca* 17,000 b.d., but potential is much greater than the current output. Parentis 11, the first marine drilled well in Europe, is producing *ca* 2200 b.d. from dolomite. There are now 8 wells producing in the field, and 2 further wells along the S. shore of the lake are being drilled. C. A. F.

704. West German output up. Anon. *Oil Gas J.*, 6.2.56, **54** (40), 79.—Oil production in W. Germany in 1955 averaged 61,224 b.d., 18% higher than in 1954. Output is estimated to increase to 73,200 b.d. in 1960. C. A. F.

705. Progress in prospecting for petroleum in Spain, 1952–1955. J. M. Rios. *Combustibles* (*Zaragoza*), 1955, **15**, 73–9.—Details of concessions, drilling equipment, and wells drilled during past 3 years in 4 areas of Spain. In the Adaro region (valley of River Guadalquivir) there are geological similarities to Po Valley in Italy, and an agreement with the Italian AGIP company has been reached for technical assistance in prospecting in this area. Geology of all exploratory areas is given. Max depth possible with available rigs is 6000 m in Valdebro region. No production has been achieved anywhere yet, but there are promising indications in Campsa area (River Ebro). A. C.

TRANSPORT AND STORAGE

706. Hydraulics for pipeliners. Pt XVI. C. B. Lester. *Pipe Line News*, 1955, **27** (12), 29–36.—A general classification of pumps and the operating characteristics of each group is given to help in the proper selection of pumps for pipeline service. There is a general trend towards the use of centrifugal pumps for large dia pipelines and for low pumping head duties. B. A. F.

707. Pipelines expand in all three divisions. R. G. Deering. *Oil Gas J.*, 30.1.56, **54** (39), 170.—A review is given of pipeline projects in the U.S.A. for natural gas, products, crude oil, and loop lines, and foreign construction is briefly outlined. G. A. C.

708. Here's the country's newest big crude system. L. R. Resen. *Oil Gas J.*, 27.2.56, **54** (43), 135.—The Butte Pipe Line Co's crude oil system is described, commencing as a 10-inch line at Poplar, Montana, and ending as a 16-inch carrier feeding into terminals at Fort Larmie and Guernsey, Wyoming, some 449 miles S. G. A. C.

709. Surveying microwave communication paths. W. C. Eddy. *Pipe Line News*, 1956, **28** (2), 50–61.—The accuracy and speed with which aerial surveys can be made has recently been demonstrated. Radar equipment was used in conjunction with altimeter and photographic equipment to determine the relief of ground between microwave tower locations along 1590 miles of the Pacific Northwest pipeline. B. A. F.

710. Safety procedures used in working on gas pipelines. G. Keens. *Pipe Line News*, 1956, **28** (2), 29–31.—When sections of gas pipelines have to be re-located, special safety precautions must be employed to prevent the outbreak of serious fires and the production of explosive gas–air mixtures. A method of tying in new lengths of pipe using a "controlled fire" method is described. B. A. F.

711. Dow reports good results from Styrofoam insulation. F. L. Resen. *Oil Gas J.*, 6.2.56, **54** (40), 95.—Results are given of insulating vessels with a lightweight rigid plastic, also method of application, on Hortonspheres at the Dow Chemical Co's Freeport, Texas, ammonia plant. G. A. C.

712. A new approach to floating roof tank protection. J. F. O'Regan and C. H. Lindberg. *Pipe Line News*, 1956, **28** (2), 34–6.—An integral foam-making and distribution system has been tested on a 150,000-brl test tank. Foam solution enters the tank close to the bottom and is carried by 3-inch flexible reinforced neoprene hose through the oil to a manifold in the top roof deck. 4 foam-producing units can then pour foam into the vapour space. Existing tanks which could not be converted were provided with 1½-inch hydrants on the upper deck. B. A. F.

713. The effect of paint colours in reducing storage tank losses. Pt II. E. L. Hoffman. *Pipe Line News*, 1956, **28** (2), 44–7.—Labour costs account for approx 80% of the total painting costs, so that it is advisable to select a good quality paint. Application by means of long nap rollers is found to be the most economical. The properties of "self chalking" paint are a compromise between durability and high reflectance. B. A. F.

714. What's ahead in non-manual welding. P. Reed. *Oil Gas J.*, 6.2.56, **54** (40), 80.—Esso Research Engineering Co have investigated several welding processes, and a new carbon dioxide method has proved the most promising. Thermite, flash, induction-pressure, gas-pressure, automatic submerged arc-welding, high temp brazing, and atomic hydrogen welding are among subjects dealt with in the article. G. A. C.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

715. Performance of a pulsed spray column. C. I. Billerbeck *et al. Industr. Engng Chem.*, 1956, **48** (2), 183–7.—The performance of a 1½-inch int dia pulsed extraction column, 6 ft long, was assessed by extracting acetic acid from methyl *iso*-butyl ketone with water as the continuous phase. Runs were made at 3 different water flow rates, keeping the organic feed rate constant. The frequency of pulsation was varied between 0 and 500 cycles/min. At the lower aq throughputs the H.T.U. decreased to a minimum with increasing pulse frequency and then increased until flooding occurred. Hold-up increased with pulse frequency at all flow rates. B. A. F.

716. Stream pollution. Various. *Industr. Engng Chem.*, 1956, **48** (2), 234–74.—The 8 papers presented in this symposium cover the effect of detergents on water streams and on the activated sludge process of water purification. Radioactive fall-out in surface waters, biochemical and biological characteristics of pollutants, the persistence of oily wastes under aerobic conditions, and the correlation of organic content with the taste and odour of drinking waters complete the symposium. B. A. F.

717. Refining continues expansion . . . who and where. Anon. *Oil Gas J.*, 30.1.56, **54** (39), 172.—Refinery projects in the U.S.A. are listed; types of unit, capacities, and state of work are catalogued. G. A. C.

718. New relief and blowdown facilities. J. R. Hannaman and A. J. Etingen. *Oil Gas J.*, 13.2.56, **54** (41), 108.—The relief and blowdown system at the Oleum refinery of Union Oil Co, California, consists of a smokeless flare stack and a flare pit, with related equipment. It has proved efficient in operation. G. A. C.

719. Compressor piping design for pulsation control and maximum compressor efficiency. J. M. Sharp and E. N. Henderson. *Oil Gas J.*, 16.1.56, **54** (37), 113.—This is Pt II of the article, and describes how an analog is used to predict performance of piping and dampness and how the data obtained are applied in designing a compressor installation. G. A. C.

720. Refinery's "action group" discuss cutting own production costs. S. Laskowski. *Nafta* (*Krakow*), 1954, **10**, 224–5.—A meeting, one of many taking place throughout industry, was opened by the refinery manager, who informed those present that during Jan.–June 1954 costs, instead of falling, rose by Zl. 158,200 (£52,733), and he described steps already taken: (1) partial substitution of refinery residues for coal as fuel; (2) use of exhaust steam in storage tanks; (3) various improvements of design and reduction in number of breakdowns; (4) economies in use of H_2SO_4 and NaOH. Various refinery sections promised to make economies in use of raw materials (steel scrap), transport, and labour. Proposed savings by Dec. 1954 should be equivalent to the cost of 40 motor cars. M. S.

721. Local preheating of petroleum products. S. Rachfal. *Nafta* (*Krakow*), 1954, **10**, 231–4.—Local preheaters are generally required for liq of visc not greater than 10° E at 50° C, and only if these are likely to freeze. If it is necessary to aid the settling process in a tank, the whole of the liq must be kept hot. Local preheaters generally surround suction pipe. Larger types can be classed as heat exchangers. They effect a considerable saving of heat and often of material pumped, compared with overall heating. Their efficiency must be maintained by frequent cleaning. M. S.

722. Inventiveness in petroleum industry. F. Sawicki. *Nafta* (*Krakow*), 1954, **10**, 193–6.—Covers an improved knife for cutting steel pipes inside wells, a float for high pressure vessels, and use of asphalt for insulating water pipes. M. S.

723. Pemex Salamanca lube oil plant. J. C. Reidel. *Oil Gas J.*, 16.1.56, **54** (37), 102.—The plant belonging to Petroleos Mexicano, situated in the State of Guanajuato, is described. It combines high vacuum dist, 2-stage furfural solvent extraction, and 3-stage solvent dewaxing, and has a high degree of instrumentation. Capacity is 2500 b.d. of lub oil blend stocks and 75 tons/day of waxes. G. A. C.

724. Shell's Geelong plant started from scratch. Anon. *Oil Gas J.*, 16.1.56, **54** (37), 119.—The 31,000-brl plant at Geelong, Victoria, Australia, is fed by tankers from British Borneo and Middle East crudes. A products pipeline connects the refinery with Melbourne. G. A. C.

725. B.P. operates complete plant at Dunkirk. Anon. *Oil Gas J.*, 6.2.56, **54** (40), 99.—A brief description is given of the 2,000,000-tons/year capacity Dunkirk refinery of the French subsidiary of British Petroleum Co. G. A. C.

726. Activities of C.E.P.S.A. (Spanish Petroleum Company). M. A. Garcillan. *Combustibles* (*Zaragoza*), 1955, **15**, 127–36.—This company operates a refinery at Teneriffe (Canary Islands) of capacity 1,800,000 tons p.a., and 2 installations at Ceuta and Las Palmas. The Teneriffe refinery commenced in 1930, with a capacity of 250,000 tons p.a., making gasoline, kerosine, gas oil, and fuel oil, and now produces in addition aviation gasoline, lubricants, wax, bitumen, and LPG. Latest additions (1955) include a Platformer and Udex unit. A. C.

727. Present and near-future operations of the Escombreras refinery. C. de Eizaguirre y Machimbarrena. *Combustibles* (*Zaragoza*), 1955, **15**, 161–5.—The REPESA refinery at Escombreras, nr Cartagena, commenced operations in 1950, with a capacity of 5000 b.s.d. crude. By 1953 additional topping, thermal reforming, and polymerization units had been installed, bringing total capacity to 30,000 b.s.d. Gaso-

line treating facilities and TEL blending were also added. By modifications to plant this throughput was increased to 40,000 b.s.d. In 1953–54 lub oil refining plant was installed (propane deasphalting, furfural extraction, MEK dewaxing, acid and clay treatment) totalling 27,000 tons finished lubricants p.a. New projects call for a capacity increase to 3,500,000 tons p.a., including a Platformer to produce premium gasoline of 93 O.N. This added capacity should be operating early in 1957, and will then cover Spain's total requirement. A. C.

DISTILLATION

728. Natural gas hydrocarbons for petrochemicals. A. S. Hester and J. F. McDonald. *Industr. Engng Chem.*, 1956, **48** (2), 168–77.—Methane is separated from natural gas by absorbing the higher hydrocarbons in a refrigerated light oil. Ethane, propane, butane, and natural gasoline are dist off from the absorbing oil and separated by fractional dist. Provision is made for recovery of the light oil from the methane and natural gas streams. Details of the equipment used are given. B. A. F.

SOLVENT EXTRACTION AND DEWAXING

729. Liquid–liquid extraction in theory and practice. Pt IV. H. R. C. Pratt. *Industr. Chem. Mfr.*, 1955, **31**, 505–10, 502–9 (*cf.* Abs. **944**, 1955).—General description of underlying principles used in extractor design work. Equations are given for predicting, in aq soln, hold-up, flooding rates, droplet sizes, interfacial area of contact between phases, transfer units, theoretical stage requirements, and column heights, from known parameters. Principles applied to design of spray and packed columns, rotary columns (annular and disk), pulsed and perforated plate columns. Design of mixer–settler extraction systems is also considered, with notes on instrumentation. 68 refs. A. C.

CRACKING

730. Carbon formation in cat cracking. P. B. Crawford and W. A. Cunningham. *Petrol. Refin.*, 1956, **35** (1), 169–73.—Equations are formulated to estimate the effect of charging rate, process period, and temp on the rate of carbon formation on cat in fixed reactors.

Methods have also been developed to apply this data from fixed-bed reactors to moving-bed or fluidized reactors.

Equations have been evolved showing the residence time of cat in the moving-bed or fluidized reactor. Such distribution data furnish the basis for summation of carbon on individual particles of cat, and thus the average carbon on the cat being charged to the reactor. R. L. R.

731. Conversion of heavy hydrocarbons by the Houdresid process. G. A. Mills *et al.* *Rev. Inst. franç. Pétrole*, 1955, **10**, 1518–24.—Use of modified (natural or synthetic) cat insensitive to heavy metals permits feeds with high S or N content. Houdriflow moving-bed unit is used, products are typical of those obtained in cat cracking. Metal contamination of cat is kept at suitable equilibrium val by attrition, relationship between loss of cat activity and metal content is shown; Ni + V can attain 0·09% without significant activity loss. Typical results given for variety of feeds: on 22% reduced Kuwait crude (cracked at 480°–510° C with recycling) 48·1 vol % 91 F_1 gasoline, 11·0 wt % gas (C_1–C_3, high olefin content, suitable for polymerization), 11·6 vol % C_4, 21·4 wt % coke, 15 vol % gas oil (suitable for diesel fuel or cracking), 9·4 vol % heavy fuel. V. B.

732. The Platforming process, its economic and industrial advantages. E. R. Muste. *Combustibles* (*Zaragoza*), 1955, **15**, 137–48.—Description of effect of process variables on reactions occurring during cat reforming by this method. Application of Platforming to production of aviation gasoline, aromatics, and synthetic chemicals is outlined. Photographs of Teneriffe Platformer. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

733. Properties of the double bond C=C. Reaction of ethylene and propylene with mercuric salts. V. G. Aranda, O. S. Pastor, and J. L. M. Cordon. *Combustibles* (*Zaragoza*), 1955, **15**, 102–20.—Forming part of a research project at present being conducted in the Zaragoza section of the National Inst of Fuel, the behaviour of ethylene and propylene with various organic and inorganic mercuric salts is described. Ethylene yields 2 series of olefin addition cpds, alcohol salts and ether salts. Propylene, even in conditions favourable to formation of ether salts, will produce only alcohol salts. Possible mechanism for reactions is advanced, and a new series of organo-mercuric compounds is prepared and described. A. C.

ANALYSIS AND TESTING

734. Definition of a characteristic number for mineral oils. H. Näcke. *Elektrotech. u. Maschinenb.*, 1956, **73**, 52–61.—Equation is given, derived from Debye theory of dielectric loss, for the characteristic No. (Zustandzahl) of refined mineral oil, which is considered as a dilute soln of polar materials in a non-polar solvent. This number is sensitive to chemical changes, as caused by removal of polar materials in refining or their accumulation during ageing. Equation represents area delimited by curve of loss figure against frequency and is valid provided ratio of higher (*ca* 10^9 Hz) to lower (*ca* 500 Hz) measurement frequencies is $>10^4$. Characteristic No. excludes effects due to water and similar non-hydrocarbon impurities. V. B.

735. Calorific value of benzole vapour. E. Spivey. *Industr. Chem. Mfr*, 1956, **32**, 93.—Errors in the nomogram published by G. E. Mapstone (*cf.* Abs. **319**, 1956) are pointed out. Reply by the author, giving correction factors to be applied. V. B.

736. Determination of benzene in cracked hydrocarbons. T. R. Crompton and V. W. Reid. *Analyst*, 1955, **80**, 605–7.—Lowest-boiling liq fractions from cracking processes contain large amounts of olefins and diolefins, which absorb strongly in the u.v.; spectroscopic determination of C_6H_6 therein can be effected by first refluxing the sample, in *iso*C_8H_{18} soln, with acid-activated clay and maleic anhydride, rendering the olefins non-volatile, distilling off C_6H_6, diluting with *iso*C_8H_{18}, determining optical *d* at 2525, 2547, and 2590 Å. Accuracy ±2%. W. A. M.

737. Possible analytical applications of infra-red absorption spectra of saturated aliphatic hydrocarbons in the 350–700 cm^{-1} region. M. T. Donneaud. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1525–31.—Results of preliminary work are given for 20 hydrocarbons (C_5–C_{20}); indications are that distinction is more marked between isomers than between homologues. In the region studied appreciably larger quantities of material are required than for measurements at shorter λ. Theoretical interpretation of results is briefly discussed. V. B.

ENGINE FUELS

738. Possible utilization of ordinary fuels in high compression engines. J. Baudry. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1532–42.—Bench tests on 4 engines, each at 2 values of C.R., lower corresponding to O.N. requirement of fuel used (78 F_1, French regular grade). At each C.R. power and fuel consumption are determined with ignition advance at optimum setting

for max power, subject to avoidance of audible knock; results showed advantage for higher C.R. Road tests in a car fitted with one of the bench-tested engines confirmed these results, max speed, acceleration, and consumption all being significantly improved. Main drawback of operating in this manner is increased sensitivity of engine to ignition advance, requiring more accurate distributor setting than has hitherto been customary (5° dispersion being commonly met with). With ignition thus retarded, increase of C.R. does not cause rise of combustion pressure above value at lower C.R. with normal ignition setting. V. B.

739. Estimation of the water content of motor fuels. H. Mosurski. *Nafta (Krakow)*, 1954, **10**, 234–7.—The author critically reviews methods available for water estimation, pointing out that the Dean and Stark method is unsuitable for highly volatile fuels and those containing water-soluble liq, *e.g.* EtOH or acetone. Other methods include: (*a*) cloud point by IP 98/44/T/20; (*b*) sp. gr. before and after drying; (*c*) dist of the 7·4% H_2O, 18·5% EtOH, and 74·1% C_6H_6 azeotrope; (*d*) chemical method using either $Al_2(OEt)_4O$ or Mg_3N_2 or CaC_2 or CaH_2 or Karl Fischer's SO_2 and I_2, all of which react with water. The last one is considered best. M. S.

740. Aviation fuels. J. M. Roman y Arroyo. *Combustibles (Zaragoza)*, 1955, **15**, 201–14.—Review of principal characteristics of jet and piston engine fuels. Bibliography. A. C.

741. Sensitivity and gasolines for tomorrow's engines. A. P. Boyd, P. C. White, and C. J. Domke. *Oil Gas J.*, 27.2.56, **54** (43), 113.—Designs of future automotive engines must recognize the trend towards more sensitive fuels, which sensitivities have increased appreciably in recent years. Tables present octane and composition data for typical cat gasolines, sensitivities of premium gasolines, and increase in F-1 octane necessary to match 9·0 sensitivity fuel. G. A. C.

GAS OIL AND FUEL OIL

742. Survey of British fuel research. Pt II. Anon. *Petroleum, Lond.*, 1955, **18** (11), 425.—Flow properties of residual fuel oils are considered from point of view of changes on storage and the effect of conditions of blending. Flocculation of asphaltenes in fuel oils was also investigated, and their effect on sludge formation considered. Work on the separation of emulsions of fuel oils and sea water was continued in order to find a shipboard system which enables 15 tons of oil/hr to be broken to give an oil containing less than 1% sea water. Tests concerned with smoke emission in sectional central-heating boilers were also carried out. J. B. S.

743. Hydrogen treatment improves fuel oils. R. P. Gilmartin, W. A. Horne, and B. R. Walsh. *Oil Gas J.*, 6.2.56, **54** (40), 85.—A new hydrogen-treating process developed by Gulf Oil Corpn improves performance of fuel oil in heating-oil equipment. A substantial reduction in sulphur content is also achieved, with consequent reduction in ring wear and deposits when the fuels are employed in diesel engines. G. A. C.

LUBRICANTS

744. Theory of hydrodynamic lubrication in parallel sliding. W. Lewicki. *Engineer, Lond.*, 1955, **200**, 939–41.—Analysis is believed to be an improvement on Reynolds' theory of lubrication. In the latter theory pressure contribution by leading face of plane slider is omitted, whereas the leading face is in itself a convergent slider, and the film of lubricant formed under the slider is usually quite substantial on scale of mol dimensions. (Précis of author's summary.) A. C.

745. Synthetic lubricants in Spain. J. M. V. Iglesias. *Combustibles (Zaragoza)*, 1955, **15**, 149–59.—In the industrial centre of Puertollano, proven reserves of bituminous shale exceed 10^9 tons, from which up to 12% of lubricants, fuels, etc., can be produced by destructive dist followed by hydrogenation. Retorts sufficient to process 3000 tons/day of shale have been installed, the resulting gases being washed with ammonia water after a primary condensation, any gasoline vapour being finally removed by scrubbing with oil. The non-condensable gases are used as fuel. It is planned to hydrogenate the combined crude shale oil at a pressure of 300 atm, and separate the hydrogenated product by dist into gasoline, kerosine, gas oil, and residual oil. The latter will be solvent dewaxed to give a hard paraffin, and the dewaxed oil vacuum dist into fractions and chemically treated before blending into finished products. Installations for production of H_2, liquid N_2, chlorinated paraffin wax (for synthetic bright stock), and H_2SO_4 from indigenous pyrites, are also projected. The total final products will be (tons) 8550 paraffin wax, 45,000 lub oils, 17,500 gasoline, 26,500 kerosine, 35,800 gas oil, 4600 HNO_3, 63,000 $(NH_4)_2SO_4$. Photographs of various plants. A. C.

746. Formation of organophilic montmorillonite–oil gels by use of a magnetostrictive oscillator. V. R. Damerell. *Industr. Engng Chem.*, 1956, **48** (2), 321–3.—Montmorillonite clays undergo ion exchange with quaternary ammonium salts to yield organophilic derivatives that will thicken organic liq. These are of importance in the production of lubricating greases, etc. Experiments showed that a 200-W, 10-kc magnetostrictive oscillator produced marked thickening and gelation of these materials. These gels were thixotropic and had poor work resistance compared with systems produced by non-rhythmical methods. B. A. F.

BITUMEN, ASPHALT, AND TAR

747. Experiences in bituminous road construction. A. von Skopnik. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (1), 5–12.—Comprehensive review of methods and materials used in road construction in Germany and abroad in 1954. 163 refs. R. T.

DERIVED CHEMICAL PRODUCTS

748. Making ethylene. 1. What are feed stocks, yields, costs? H. C. Schutt and S. B. Zdonik. *Oil Gas J.*, 13.2.56, **54** (41), 98.—This is the first of a series of articles on the production of ethylene and gives details on feedstocks which may be used, expected yields, and relative costs. G. A. C.

749. Petrochemicals in 1955. Anon. *Petrol. Refin.*, 1955, **34** (12), 123–203.—A very thorough presentation of the raw materials and petrochemical processes available today, and possible trends for the future. Processes vary from production of chlorinated methanes and ethanes to several methods for ammonia and urea production. Both high and low pressure polymerization of ethylene are dealt with, and also production of vinyl chloride monomer.

A separate section deals with different methods used for the separation of reaction products. Both azeotropic and extraction dist are discussed; solvent extraction for recovery of butadiene, sulphur dioxide Udex, and *iso*butylene extraction processes are described. Hypersorption process using charcoal for the separation of volatile hydrocarbons is also given. R. L. R.

MISCELLANEOUS PRODUCTS

750. Technology of obtaining and refining resin. W. Huntenburg. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (1), 29–31.—Pt 1. An intensive review of sources of natural resins and methods of obtaining them—secretions, scraping, tapping, solvent extraction, etc.—from conifers. Dist methods at various temp and chem changes in products are discussed with special reference to colophony. Numerous references to authors and relevant patent specifications appear. 22 refs. R. T.

CORROSION

751. How to reduce hydrogen attack. G. R. King. *Petrol. Refin.*, 1956, **35** (1), 124–8.—A discussion on the methods of minimizing hydrogen attack in steel vessels, there being no absolute countermeasure at the present moment. On a local basis, where more concentrated attack occurs, such as the vapour phase in depentanizer and depropanizer drums, a protective liner will provide ample countermeasure, concrete providing the most economical lining where the vessel can be removed for repairs at fairly frequent intervals; otherwise alloy steels or neoprene type rubbers must be used.

If cyanide is the corrosion accelerator, some combination of water washing and air injection seems to be the most effective countermeasure, but problems of proper water contact of the gas streams and disengaging facilities apparently limit the effectiveness of this method.

Probably the limiting factor in air injection is the time lag in the stepwise reactions, which, being reversible, may require a large excess of oxygen for complete reaction of all the cyanides. R. L. R.

752. What happens in hydrogen–hydrogen sulphide corrosion. E. B. Backensto, R. D. Drew, and C. C. Stapleford. *Petrol. Refin.*, 1956, **35** (1), 147–51.—The article describes the effect of hydrogen sulphide with hydrogen corrosion attack in the temp range 985°–1175° F and pressures between 175 and 485 p.s.i.g. on 0–5% and 7–16% chrome steels and chromium–nickel alloys.

The corrosion rates for the chrome steels increase with hydrogen sulphide concn, particularly for the low chrome steels, the rate curves usually dropping off rapidly in the 7–16% chrome range.

Tests were made at very low hydrogen sulphide concn to determine the minimum concn that would cause scaling, and also the nature of the scale, since if the scale adhered tightly to the metal further corrosion would be avoided. However, it was found that a thin film of powdery corrosion products appeared on steels containing up to 2·25% chrome at 0·006% vol hydrogen sulphide; this type of corrosion being evident for all steels containing up to 9% chrome at 0·01% vol hydrogen sulphide. In no case was there evidence of scale on the chrome–nickel alloys, and from lab observations flaky corrosion scale formed on steels which have corrosion rates of *ca* 0·01–0·02 inches/year, regardless of their chrome content. R. L. R.

753. Watch minor constituents for corrosion. E. V. Kunkel. *Oil Gas J.*, 27.2.56, **54** (43), 126.—Operating data are presented on constituents in processing systems, such as acetic and formic acids, formaldehyde, and similar cpds in small concn concerned in corrosion. G. A. C.

754. How new internal coatings are proving their worth. W. T. Theis. *Oil Gas J.*, 13.2.56, **54** (41), 151.—The history of the development of internal pipeline coating is reviewed, the new epoxy-resin coating is dealt with, and its performance to date exampled. G. A. C.

755. Deterrence of hydrogen blistering at a fluid catalytic cracking unit. B. W. Neumaier and C. M. Schillmoller. *Corrosion Tech.*, 1956, **3**, 81–5, 96.—It has been found that any steel which corrodes can be subject to hydrogen attack. The nature of the steel determines the type of damage which will occur. Cold-working of steel greatly increases its susceptibility to hydrogen penetration. High corrosion rates are not necessary, and blisters at corrosion rates of 0·001 inch p.a. have been reported. Fissuring and embrittlement are other types of damage which result from hydrogen attack.

The paper, which is in 2 parts—the second will be published later this year—endeavours to formulate answers to the following questions: (1) Where has the majority of hydrogen damage been found? (2) What corrosive environment do these locations have in common? (3) What measures can be taken to stop hydrogen penetration? (4) Why has hydrogen blistering not been apparent in cat cracking until recent years? (5) Are cyanides as promoters of hydrogen blistering over-emphasized? (6) What tools are available to detect hydrogen penetration at an early stage? 5 figs, 9 refs. M. P. T.

MISCELLANEOUS

756. Production tomorrow. R. Katzen. *Petrol. Refin.*, 1955, **34** (12), 110–15.—Production figures and costs are presented for a range of products from the hydrocarbon intermediates and polymers to phenols and the aliphatic chemicals. The increasing competition from other raw material sources, such as coal, wood, sugar, etc., is also discussed. R. L. R.

757. Raw materials today. J. J. McKetta and T. C. Ponder. *Petrol. Refin.*, 1955, **34** (12), 116–19.—The question of selection of raw material, cost, and availability is discussed for the petrochemical industry using natural gas, LPG, refinery off-gases, or fuel oil. R. L. R.

758. Half-yearly summary of plan fulfilment in the refining industry. S. Laskowski. *Nafta* (*Krakow*), 1954, **10**, 191–2.—This covers first and second quarter of 1954. The salient points shown in 2 tables are that home production of crude is lagging by 0·3% behind plan and behind 1953 figures. Imports of crude are 25% up on 1953, but still below the 1954 plan by under 5%. Imported crude exceeds Polish crude by 1%. Production of all fuels is within ±7% of plan targets, except kerosine, which is 11% lower than planned and 27·5% less than in 1953. Greatest progress since 1953 can be observed in production of regenerated and selective-refined oils (over 50% rise). From other considerations it is shown that value of products/man has risen slightly and costs/ton have fallen by 5%. M. S.

759. Erection of a modern refinery is an urgent economic necessity. P. Lipka. *Nafta* (*Krakow*), 1954, **10**, 190–1.—Consumption of petroleum products at the end of 1952 reached a level anticipated for end of 1955. Existing refineries are often past reconstruction. Importation of crude is much more advantageous than finished products, some of which are becoming scarce. A new refinery must be built during the next planning period. M. S.

760. Make your design calcs easier. J. C. Reidel. *Oil Gas J.*, 13.2.56, **54** (41), 113.—This is a brief report on a recent symposium on thermodynamics held in Oklahoma. Generalized thermodynamic properties, volumetric and phase behaviour, and statistical considerations are matters dealt with in the report. G. A. C.

761. Here's some new developments in petroleum packaging. C. E. Smith. *Oil Gas J.*, 27.2.56, **54** (43), 124.—Pictures and descriptions are given of some of the newer machines now in use for petroleum packaging operations, including 5-gal filling machine, case opener, and flex-bend conveyor. G. A. C.

BOOK REVIEWS

Fuel, solid, liquid and gaseous. J. S. S. Brame and J. G. King. London: Edward Arnold, 1955. Pp. xii + 551. 50*s*.

This book is the fifth edition of a well-known classic in the field of fuel technology.

Since the previous edition appeared in 1935 (*J. Instn Petrol. Tech.*, 1935, **21**, 464A.) this field has undergone a profound modification, brought about by the increased demands for energy due to the enormous expansion of the industry during and after the second world war. In order to meet these demands refined methods of raising power have been devised, improving the economy of the operations. At the same time, new methods of upgrading fuels have been put into practice, resulting in the production of fuels particularly suited to the exacting demands of more economical types of engine. Finally, the advent of nuclear energy opens an entirely new field, with possibilities almost beyond imagination, pointing to a complete revolution and transformation of what the world actually is.

The aim of the work, as the authors point out in their introduction, is to provide an account of the use of the common types of fuel at a science graduate level.

After an introductory chapter reviewing the known power sources, including a short account on the actual position of atomic energy and some statistics of the world fuel resources and consumption, two chapters are given as an introduction to the basic properties of fuels (combustion and inflammability characteristics).

The second part, comprising six chapters, deals with solid fuels—coals—their composition and classification, with a particular reference to the British and Commonwealth coals. After coal treatment and briquetting the use of solid fuels in grate boilers and in powdered form are reviewed and a section is devoted to coal as a fuel for the gas turbines, and to the production and characteristics of coke.

The third part studies liquid fuels, starting with a short review on the basic petroleum refinery operations and including a chapter on the production of liquid fuels from coal by the Bergius and Fischer–Tropsch processes. The main emphasis is put on the individual commercial products, especially on the different types of equipment for burning fuel oils. Light distillates are dealt with in a separate chapter, which includes a study of the combustion characteristics of gasolines, leading to a rather sketchy treatment of their knock tendencies and knock rating. This chapter also deals with the kerosine fractions and the use of kerosine in aviation turbines. Benzole and alcohol are dealt with as components for motor fuel blends and a very short chapter deals with the use of gas oil fractions as diesel engine fuels.

The fourth part is devoted to gaseous fuels, the production of town gas, the gases obtained from refinery operations, liquefied gases and natural gas, combustion characteristics and equipment to burn gaseous fuels. A separate chapter deals with the production and technology of low calorific value fuels, including the underground gasification of coal. This part ends with a study of the production of water gas and the modern processes for the production of town gas.

The fundamentals of analysis of fuels are given in one chapter, although throughout the book, when dealing with the individual products, hints are given of different and more specialized types of analysis and determinations. Another chapter deals with the calculation and determination of the calorific value of the different fuels, with the description and operation of different types of calorimeters.

Finally, there is a chapter on coal specifications, the efficient use of fuels, and the control of combustion.

The book is well produced, neatly arranged, and with abundant diagrams and tables. There is a good list of references at the end of each chapter.

The only criticisms to this altogether admirable work, well up to the standard of the previous editions, is that some of the theoretical treatment is rather elementary for the level intended, and that its wealth of statistical data tends to obscure some of the basic concepts. A. S.

Fifth Symposium (International) on Combustion. Combustion in Engines and Combustion Kinetics. Published for the Combustion Institute under the auspices of the Standing Committee on Combustion Symposia. New York: Reinhold Publishing Corpn; London: Chapman and Hall, 1955. Pp. xxvi + 802. 120*s*.

The fifth symposium on combustion was held in Pittsburgh, 30 Aug. 1954. 11 invited speakers addressed the symposium, each speaker reviewing the recent advances in a specialized field of combustion research. 90 original papers were presented in the following groups: combustion of fuel droplets (6); propellant burning (9); combustion of solids (6); diffusion flames and carbon burning (5); combustion in engines (8); special techniques (5); kinetics of combustion reactions (45); flame spectra and dissociation energies (6). The panel discussions which followed the meeting are summarized by the respective chairmen, namely, "Heterogeneous Burning," by H. C. Hottel, and "Status of the Theory of the Kinetics of Combustion Reactions," by A. R. Ubbelohde.

The remarkable preponderance of papers on the kinetics of combustion reactions indicates the development which has taken place in this particular field of combustion studies. The fourth symposium focused attention on the physics of combustion, and by agreement the fifth symposium was designed to emphasize the importance of reaction kinetics in these studies. The book therefore forms a continuation of previous symposia, and in particular gives a wide coverage to recent advances in kinetic studies.

The book is excellently produced and well indexed. The illustrations are excellent, particularly the graphical presentation of data of which wide use has been made by the various authors. Literature references are given in each paper, but no general reference index has been included. To workers in any branch of the field of combustion, this is a most important book, and one which all interested in combustion or hydrocarbon chemistry will wish to possess.

F. M.

ADDITIONS TO THE LIBRARY

Some Properties of the Lighter Hydrocarbons, Hydrogen Sulfide, and Carbon Dioxide. Bruce H. Sage and William N. Lacey. Monograph on API Research Project 37. New York: American Petroleum Institute, 1955. Pp. 246. $10.00.

The information in this book is another example of the impressive practical steps which the API take to promote systematic advance in the knowledge required in the evolution of the petroleum industry. Nearly all the information has been published without delay as it has become available since 1947, but, whilst a complete list of references to these publications is included, the present book is a more convenient text. Where necessary, figures have been recalculated to ensure consistency with a related monograph on the thermodynamic properties of the lighter paraffin hydrocarbons and nitrogen, published by the same authors in 1950. Both books contain data assembled to help in understanding the behaviour of gases present in crude

petroleum, but this information is also of general use in chemical engineering and physical chemistry.

The care which has been customarily associated with API publications has obviously been again applied to the reproduction of these tables and graphs to consolidate their value.

Statistical Summary of the Mineral Industry—Production, Exports and Imports 1949–1954. Colonial Geological Surveys, Mineral Resources Division. London : HMSO, 1956. Pp. 359. £1 7*s*. 6*d*.

Detailed figures are given of crude oil production throughout the world for the six-year period 1949–54, together with the production of natural gasoline, natural gas, asphalt rock, natural asphalt, and oil shale. In addition to the petroleum production figures, details are given regarding the output of the principal products from refineries in a large number of countries. Details of exports and imports of petroleum products for all countries are also included.

This compilation is an extremely useful guide, not only to the petroleum industry but also to the whole of the mineral industry of the world, and an appendix gives a comprehensive list of statistical publications.

Guide du Pétrole, 1955–56. O. Lesourd. Paris : Editions O. Lesourd, 1955. (23rd edn). 2 vols. I. Reglementation. Pp. xxxvi + 611. II. Annuaire. Pp. 352 + 108 + 190. Fr 6205, post free.

Following the changes made in the previous edition (*cf. J. Inst. Petrol.*, 1955, 92A), whereby the book was divided into two volumes, the present edition follows almost exactly the layout and general plan set in the previous year. Among legislative changes (which have been covered up to the end of Aug. 1955), mention may be made of the proviso whereby lubricating oil additives that are classed as dutiable chemicals may nevertheless be imported duty-free into bonded premises for incorporation into oils for export or bunkering, although liable to duty when mixed with oils for internal consumption.

Interchangeability of High-BTU Oil Gases and Natural Gases. E. F. Searight, H. R. Linden, D. L. Nicol, and E. S. Pettyjohn. Institute of Gas Technology Research Bull. 24. Chicago, Ill. : The Institute, 1956. Pp. 60. $5.

This study demonstrates the effect of operating conditions and modifications with diluents on the substitutability of oil gases in the 900–1700 B.t.u/S.C.F. range. It reports the maximum percent oil gas in mixtures of oil gas and base high-methane and high-inert natural gases which exhibited satisfactory combustion performance on critical burners and contemporary appliances. The burners included range and refrigerator types, and the work was carried out in the IGT utilization laboratories under the sponsorship of the American Gas Association.

Distillation Literature Index and Abstracts 1953–54. Arthur and Elizabeth Rose. State College, Pennsylvania : Applied Science Laboratories Inc., 1955. Pp. 412. $12.50.

This volume follows the general arrangement of its predecessor covering 1946–52, although a few changes have been made in the subject index scheme. Thus, new sections on vacuum distillation of metals and on vapour–liquid equilibrium data for thermodynamic correlation have been added, and an attempt has been made to cover completely references on vapour–liquid equilibrium data.

Zur Anwendung des Leichtbaues bei Erdölbohr- und Fördergerüsten. Dipl-Ing Erich Bahke. Hannover : Technischen Hochschule, 1954.

ASTM Standards on Petroleum Products and Lubricants. Philadelphia : American Society for Testing Materials, 1955. Pp. 950 + xxviii. $6.50.

This 1955 edition contains details of all standard and tentative ASTM test methods, etc., for petroleum products and lubricants. New tentatives are D1367 for lubricating qualities of graphite, and D1368 for trace concentrations of TEL in primary reference fuels. Several tentative methods have been advanced to standard and a number of tentatives have been revised in certain respects. Two standards—D322 for dilution of crankcase oil, and D1019 for olefinic plus aromatic hydrocarbons in petroleum distillates—have been reverted to tentative, and some standards have been revised.

The report of Committee D-2 is in the volume and includes details of a number of proposed methods. Other matters of interest to the petroleum and petroleum-using industries are incorporated.

British Standards :

B.S. 245 : 1956. Pp. 35. 6*s*. net, post free.

This specification for white spirit has been completely revised, and in respect of several properties tolerances have been set at closer limits. Material is no longer restricted to the paints field, and methods of test are attached as appendixes and are based upon IP current specifications.

B.S. 2637–8 : 1956. Pp. 39. 6*s*. net, post free.

These two standards are included together in one set of covers, and the methods contained are "Knock-rating of motor fuel (Motor method)" (B.S. 2637), and "Knock-rating of motor fuel (Research method)" (B.S. 2638). The two methods are technically identical with those standardized by the IP as IP 44/55 and IP 126/55 respectively.

B.S. 2708 : 1956. Unified Black Square and Hexagon Bolts, Screws, Nuts (UNC and UNF Threads) and Plain Washers. Normal Series. Pp. 32. 5*s*. net, post free.

B.S. 2710 : 1956. Bromomethane (Methyl Bromide). Pp. 10. 2*s*. 6*d*. net, post free.

B.S. 2711 : 1956. Cyclohexanone. Pp. 8. 2*s*. 6*d*. net, post free.

B.S. 2712 : 1956. Dipentene. Pp. 9. 2*s*. 6*d*. net, post free.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

762. Origin of petroleum—a review. N. P. Stevens. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 51–61.—The origin of oil has intrigued and challenged geologists, chemists, physicists, and microbiologists for many years. The chemical complexity of crude oil; its fluid, hence migratory nature; and the innumerable geological factors that must be considered, present a considerable challenge to the investigator. Many theories have been proposed to explain the origin of oil. Some are plausible, others no less than fantastic. A few theories, though sound from a chemical point of view, ignore basic geologic factors, and therefore must be rejected. This paper is a review and an evaluation of the more significant contributions in the light of present-day knowledge.

E. N. T.

763. Argument for diastrophic control of late Palæozoic cyclothems. J. M. Weller. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 17–50.—The diastrophic control theory, favoured by the writer, holds that cyclothems owe their development to repeated oscillations, each consisting of a long gradual subsidence followed by a short, sharp uplift, both centring in the area from which the major part of the sediments was derived but operating also in the basins of sedimentation. It is based on generalizations concerning the cyclical repetition of similar members and their characters, the alternation of non-marine and marine strata, the asymmetrical nature of cyclothems, and the widespread development of many members which are believed to be essentially time-stratigraphic units.

The conclusions are reached that uplift and depression alternately affected both source area and basins and that these movements were synchronous and similar in both regions. At times of uplift erosion was rapid in the source area, and coarse sediments were transported across a sloping alluvial coastal plain. At times of subsidence erosion was less active, and finer sediments were transported more slowly across a contracting, more gently-sloping alluvial plain into a transgressing sea.

The diastrophic control theory does not explain all features of late Palæozoic cyclothems, and many interesting problems remain for future investigation in this fascinating and complex field of stratigraphic research.

E. N. T.

764. Model studies of salt-dome tectonics. T. J. Parker and A. N. McDowell. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (12), 2384–470.—Approx 800 models were constructed during the course of the investigations described. Some of these were

small, simply-constructed models designed to study the behaviour of a particular material or to determine the effectiveness of a certain lab technique. Others required days or weeks to construct, involved several hundred lb of materials, and were observed and photographed over periods of several days, a few of them for several weeks. *Ca* 20% of the models were considered to be of sufficient geologic significance to merit careful study and description; most of these were either sketched or photographed.

When the thickness of overburden above the top of a model dome exceeded a certain value, no further movement of the dome occurred, provided that the overburden had a finite shear strength. The actual thickness required to prevent the growth of a dome depended on the height of the dome above its source layer, the density contrast between the overburden and the salt equivalent, and the strength of the overburden. In the models that were considered to be most nearly dimensionally correct, this critical thickness was approx the same as the height of the dome above its source layer. E. N. T.

765. Folding of unmetamorphosed strata superjacent to massive basement rocks. F. S. Hudson. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (10), 2038–52.—Folds in beds resting unconformably on massive cryst rock, with the basal contact of the strata undulating in conformity with the overlying anticlines and synclines, were first recognized and described many years ago.

4 areas are described where the cryst basement, unconformably subjacent to beds which have been folded by tangential compressive forces, has been partly denuded of its cover of strata, thus affording the opportunity to compare the shape of the basement surface with the structure of the overlying beds.

A number of conclusions are presented, and it is shown that in accordance with earlier views the Mid-Continent folds of the Plains type appear to be, in large part, the result of tangential compression. E. N. T.

766. How the time element affects oil traps. R. H. Paschall. *Oil Gas J.*, 5.3.56, **54** (44), 151.—Examples of the geological history of 2 areas have been selected to show that the history of changing structure as well as the present structure must be considered when investigating the oil potentialities of an apparently favourable area. C. A. F.

767. Factors influencing precipitation of calcium carbonate. E. J. Zeller and J. L. Wray. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 140–52.—Aragonite, calcite, and vaterite have been precipitated under conditions of controlled temp, pH, and impurity ion concn. Results from X-ray diffraction studies, spectrographic analyses, microscopic examination, and thermoluminescence studies have provided information regarding the factors affecting the formation of the various cryst forms. The immediate factor influencing the form of calcium carbonate precipitates is the impurity content of the crystals. E. N. T.

768. Palæogeographic reconstructions from cross-bedding studies. W. F. Tanner. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (12), 2471–83.—Cross-bedding " dip " directions have high value in making palæogeographic reconstructions. Measurements taken from rocks of 3 different geologic eras, in 4 states (Georgia, Alabama, Florida, and Oklahoma), plus modern measurements, are described. Comparisons of the data so obtained, with known palæogeographic maps, indicate in many places that channel (river) and littoral currents can be differentiated. At one place an estuarine environment is suggested. E. N. T.

769. Role of concurrent deposition and deformation of sediments in development of salt-dome graben structures. J. B. Currie. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 1–16.—The mechanics of graben development over deep-seated salt domes are described and illustrated by results of sectional-model experiments and study of the Heidelberg field, Mississippi. Relative vertical uplift of the salt produces graben structures in the overlying sediments. Within these structures downward movement of rock material occurs by wedge-shaped blocks. Fault movement at one boundary of a block is accompanied by similar movement along one or more fault planes at the opposing margin of the wedge. Increase of fault throw with depth and abnormally thick sections in graben blocks constitute effects impressed on the geometry of graben structures by deposition of sediments during deformation of the underlying strata. E. N. T.

770. History of concepts of Gulf Coast salt-dome formation. L. L. Nettleton. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (12), 2373–83.—This paper reviews the development of ideas of salt-dome formation in the Gulf Coast, leading to the concept of fluid-like flow under gravitational forces due to the salt being lighter than the sediments.

Experiments using a combination of fluids and soft materials with a small but definite shear strength, with deformation due to gravitational forces arising from differences in density, and with mechanical properties which are at least roughly correct mathematically, give results which appear to simulate actual dome formation fairly well. The model dome forms and the deformation of the adjacent materials are reasonably consistent with those known from geophysical results and drilling, particularly since the general use of electric logs has shown the common occurrence of rim synclines and faulting over and around the domes. E. N. T.

771. Gypsum Spring formation, Northwestern Black Hills, Wyoming and South Dakota. W. J. Mapel and M. H. Bergendahl. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 84–93.—The Gypsum Spring formation, of Middle Jurassic age, crops out sporadically for a distance of *ca* 150 miles along the W. and N. flanks of the Black Hills in Wyoming and S. Dakota.

The formation is *ca* 125 ft thick at its northwesternmost exposure 10 miles NE. of Hulett, Wyoming, where it consists of a lower sequence of massive gypsum and red claystone *ca* 75 ft thick and an upper sequence of interbedded light grey limestone and red and grey claystone *ca* 50 ft thick. The formation thins irregularly S. and E. as a result of truncation by the overlying Sundance formation of Late Jurassic age. The contact of the Gypsum Spring on the underlying Spearfish formation of Triassic age is also unconformable. E. N. T.

772. Brackish water and its structural implications in Great Carolina ridge, North Carolina. H. E. Le Grand. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (10), 2020–37.—The finding of surficial brackish water in Bladen County, N. Carolina, has led to a study of the Great Carolina ridge, known heretofore merely as a wide SE.-trending uplift of Cretaceous strata of the Atlantic Coastal Plain. The brackish water is unusual because of its surficial occurrence in the hinterland and because, as its chemical character proves, it represents artesian water rising to the ground surface presumably along a fault, through breached clay beds and unconsolidated sands. The fault, trending slightly E. of N., marks the W. border of a broad, doomed area of brackish ground water W. of Wilmington. The area is elongate northeastward, indicating that NE.-trending structures form a barrier of low permeability which has retarded the flushing of salty water from the artesian beds.

All lines of evidence, including published results of a magnetic survey, support the existence of complex NE.-trending structures. The writer believes that, contrary to general opinion, the Carolina ridge, containing an undrilled area of 8000 sq. miles, has structures that deserve attention if oil-prospecting becomes more active on the Atlantic Coast. E. N. T.

773. Radio-activity and uranium content of some Cretaceous shales, Central Great Plains. H. A. Tourtelot. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 62–83.—The Sharon Springs member of the Pierre shale of Late Cretaceous age, a hard black organic-rich shale, similar in many characteristics to the Chattanooga shale, is radio-active throughout central and W. South Dakota, most of Nebraska, N. Kansas, and NE. Colorado.

In the Great Plains region, the upper 30–50 ft of Cretaceous shales overlain unconformably by the White River group of Oligocene age have been altered to bright-coloured material.

Radio-activity in the Sharon Springs member is thought likely to be from uranium that was incorporated with the shale when it was deposited. Radio-activity in the shales directly beneath the White River group is thought likely to be related to geologic processes acting on the shales prior to the deposition of the White River group or during and afterwards.

E. N. T.

774. Late Cretaceous stratigraphy of Black Mesa, Navajo, and Hopi Indian reservations, Arizona. C. A. Repenning and H. G. Page. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (2), 255–94.—The Cretaceous rocks of Black Mesa are a result of neither the oldest nor the youngest deposition of Cretaceous time in the W. interior of the U.S.A., but represent deposition during the relatively short span of time involved in the greatest SW. extension of Cretaceous seas in this part of the continent. They illustrate plainly that the initial inundation, although gradual, was persistent and rather rapid in comparison to the long history of shoreline fluctuation that accompanied the slow and hesitant retreat of the sea from the interior of the U.S.A.

E. N. T.

775. Southwest Williston attracts fresh interest. F. J. Gardner. *Oil Gas J.*, 13.2.56, **54** (41), 171.—An important new field has been found in E. Montana on the extreme SW. flank of the Cedar Creek anticline; it is the Repeat field and the discovery, 1 Government in Carter County, has found Ordovician Red River pay at *ca* 8000 ft. Recent developments along the S. end of the Cedar Creek anticline promise further discoveries in the area; recently the Silurian has given substantial production in the Pine Field, 70 miles NW. of Repeat.

C. A. F.

776. North Central Oklahoma offers good possibilities. R. R. Patton. *World Oil*, 1956, **142** (1), 86.—There are good possibilities of finding new reserves in N. Central Oklahoma, where previous development has proved good reservoir rocks and traps. Oil was first found in the area in 1904, and since then over 600 million brl oil and much gas have been produced from *ca* 36 reservoir rocks consisting of sandstones, limestones, and other rocks ranging from Ordovician to Permian.

Over 325 fields have been discovered, and many are multi-zone fields.

The geology of the area is described and the principal exploratory tools are outlined. Surface mapping and core drilling have been useful, but are not always reliable for interpretations at depth. Seismic work also has limitations, but modern logging and testing methods have given increasingly valuable data for subsurface mapping.

C. A. F.

777. Correlation of Mesozoic formations of Utah. W. L. Stokes, J. A. Peterson, and M. D. Picard. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (10), 2003–19.—A correlation chart of the Mesozoic rocks of Utah has been prepared by a special committee of the Intermountain Association of Petroleum Geologists. For the purposes of illustrating the stratigraphic divisions and correlations of the Mesozoic, the state has been divided into 20 different physiographic and stratigraphic provinces, each represented by a column in the chart. The work represents a summary of approx 100 published papers, as well as considerable unpublished material, particularly on subsurface correlations.

E. N. T.

778. Exploration continues in Nevada. Anon. *World Oil*, 1956, **142** (1), 96.—Although exploration in Nevada is continuing, only one field has been found; this is in Railroad Valley, *ca* 65 miles SW. of Ely. 3 wells are producing from Tertiary agglomerate at *ca* 6500 ft. The estimated proven area (based on the 3 wells) is *ca* 250 acres.

A wildcat is to be drilled near Elko in NE. Nevada.

C. A. F.

779. Mesozoic sequence in Colville River region, Northern Alaska. G. Gryc *et al.* *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (2), 209–54.—The sequence of Mesozoic rocks in N. Alaska is best exposed along the Colville River and its tributaries.

As exploration in N. Alaska has been suspended, no new stratigraphic information is being accumulated. All the stratigraphic data now available has been re-studied, resulting in changes in classification in the sedimentary rocks of the region. This progress report presents the Mesozoic stratigraphic nomenclature that has been developed.

E. N. T.

780. Red Earth—Canada's incendiary discovery. J. C. McCaslin. *Oil Gas J.*, 5.3.56, **54** (44), 151.—A well 220 miles NW. of Edmonton in the Peerless Lake area, Alberta, on test flowed 792 b.d. of 38° oil from granite wash at *ca* 4800 ft; the discovery was sited on seismic and subsurface data. Several fields have recently been found productive in the wash, which is thought to have an important potential.

C. A. F.

781. Lower Tertiary of Puerto Rico. C. A. Kaye. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 108–21.—Palæontologic evidence has been found that the much deformed complex of older rocks of Puerto Rico includes deposits of Palæocene, or early Eocene, as well as Late Cretaceous age. The establishment of this fact confirms the deduction of some of the earlier writers on Puerto Rican geology, although their idea that the Lower Tertiary was represented in the older rocks of the island temporarily fell into disrepute for lack of well-buttressed fossil evidence. The findings reported in this paper are more than of local importance, however, for within a wider framework they demonstrate an example of the imperfect state of present knowledge of some of the most essential details of Antillean geology.

E. N. T.

782. Submarine sliding in Western Venezuela. O. Renz, R. Lakeman, and E. van der Meulen. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (10), 2053–67.—This paper refers primarily to the occurrence of slabs and boulders of pre-Cretaceous, Cretaceous, and Palæocene rocks within the Palæocene and Eocene shales of the state of Lara (NW. Venezuela). These occurrences are explained by submarine sliding from submerged escarpments toward the centre of the sedimentary basin.

It is believed that this allochthonous material originated from the breaking-off of submarine escarpments caused by vertical tectonic displacements along the edges of the Barquisimeto trough. This material is thought to have moved by gravitational sliding toward the centre of the trough; it has been encountered at distances of at least 30 km from its nearest possible source.

E. N. T.

783. Ages of Tertiary formations in Northwest Peru. R. M. Stainforth. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (10), 2068–77.—The age assignments of the Tertiary formations of NW. Peru have changed considerably since the first attempts to date them. This paper summarizes the reasons underlying the currently accepted chronology.

E. N. T.

784. Algeria wildcat hits. . . . Libya looks better. Anon. *Oil Gas J.*, 13.2.56, **54** (41), 95.—A wildcat in Algeria *ca* 3 km from the Libyan border is reported to have tested 300 b.d. from Carboniferous at shallow depths. The test is *ca* 940 miles from Algiers. A previous well *ca* 300 miles to the SW. of the new wildcat found gas in 1954.

C. A. F.

785. Deep well testing. Anon. *Oil Gas J.*, 5.3.56, **54** (44), 81.—A wildcat in the Potwar basin of W. Pakistan has been tested at *ca* 12,000 ft in Eocene limestone; favourable results are reported.

Pakistan is producing *ca* 5700 b.d. from 3–4 small fields in the Potwar basin: Balkasser, Dhulian, and Joyamair.

C. A. F.

786. Geological structure of the Bujavica gas field. S. Galovic. *Nafta* (*Yugoslavia*), 1956, **7** (1), 1–9.—The Bujavica gas field E. of Banova Jaruga, which was discovered in 1918, had been

exhausted by 1942. Judging from scarce data and reserve estimations, the field might have yielded *ca* 50 million cu. m. of gas. The structure of Bujavica is a dome with a long axis of 1100 m and a short one of 500 m. Geographically and geologically the structure forms part of the trough of the Ilova river, a left tributary of the Sava river. The basic rocks developed as granite were met at the depth of 1332·1 m. In transgressive form upon the granite are deposited oligo-miocene limnetic sediments developed in facies of shales, sandstone, and conglomerates. These sediments are 580 m thick. Upper miocene deposits developed in facies of shales, lithotamnia-sandstones, and slaty bituminous shales lie from 752 to 588 m over the oligo-miocene sediments. The pliocene sediments of the typical Sava basin development in facies of limy shales and sands lie concordantly upon the miocene deposits. The pay belongs to the middle pliocene with Paradacna Abichi. The lower gas horizon was recognized at a depth of 370–400 m. Its thickness amounted to 2–16 m. A restricted area of the gas horizon contained a small amount of oil which had not been exploited. The upper or the so-called principal gas horizon was discovered at 340–360 m. Its thickness was 2·6–13 m, and it contained dry gas only. The gas was used for the production of carbon black in a small plant erected near the settlement of Bujavica, and for lighting of railway carriages. (Author's abstract.)

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

787. Velocity surveys in wells. W. W. Sarvin and L. P. Stephenson. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1433–5.—In conventional velocity surveys a shot is fired at the surface near the well, and the pulse is received by one or more geophones placed at known depths in the well. From the travel time, time-depth, average velocity-depth, and interval velocity curves can be constructed. The last, in particular, will normally not be highly accurate. At shallow depths vibrations travelling via the cable may not be clearly separated from those passing through the rocks.

Continuous velocity surveys have been made by 2 devices. The SSC device has a magneto-striction pulse provider 2 m above and acoustically isolated from a crystal receiver. The energy passes through the mud to the rock, and after traversing the rock back through the mud to the receiver, unless the device is in contact with the wall of the hole. Contact is not possible where the hole is enlarged, and a caliper survey is needed to give the corrections. This instrument gives a continuous record at 50 m/min, and the curve resembles a resistivity log.

The Lane–Wells instrument has 2 receivers 3 m apart, and a pulse generator 0·8 m below the lower receiver. The 2 receivers afford certain advantages, but with only 6 pulses/minute continuity like that of the SSC device is not possible.

Continuous recording is likely to throw light on various problems. G. D. H.

DRILLING

788. Introduction to electric logging. J. E. Walstrom. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1339–43.—The first attempts at electric logging were made at Pechelbronn in 1927. Operations began in Venezuela and the U.S.A. in 1929. The S.P. log was introduced in 1931. Electric logging is used for correlation on regional or local scales. It is helpful in estimating the amount of oil in place, particularly in sands and sandstones, and may be best when supplemented by core data. Some measure of productivity may be possible from electric logs when compared with those of wells already producing. The logs may show the most suitable place for sidewall coring for lithological or palæontological data or fluid content, or for testing or running a dipmeter. A series of logs may be run at intervals, to ensure that the entire hole is not lost without logging, and to get some data before excessive invasion has occurred.

A list of symbols used in electric logging is appended. G. D. H.

789. Preliminary data for the interpretation of electric logs. M. Martin. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1344–6.—The fundamental parameters R_{mf} (resistivity of filtrate), R_w (resistivity of swept zone), and R_t (true formation resistivity) are required for quantitative interpretation of electric logs. For non-consolidated beds $\phi = \frac{0{\cdot}75}{S_{xo}}\left(\frac{R_{mf}}{R_{xo}}\right)^{\frac{1}{2}}$, and for consolidated beds $\phi = \frac{1}{S_{xo}}\left(\frac{R_{mf}}{R_{xo}}\right)^{\frac{1}{2}}$, while $S = S_{xo}\left(\frac{R_{xo}}{R_{mf}}\frac{R_w}{R_t}\right)^{\frac{1}{2}}$, ϕ being the porosity, S the water saturation, and S_{xo} the water saturation in the swept zone. In some areas it has been possible to make good interpretations without knowing R_t exactly, or having knowledge of R_{xo}.

The macro-sonde is affected mainly by a vol of rock of 1–10 m³, and this generally extends beyond the invaded zone. Focusing devices may reduce the influence of mud. Micro-sondes are affected mainly by a few cc of rock adjacent to the well wall, and so give more detail than the macro-sondes; they are much affected by any mud cake, and this may make the detection of permeable zones easy. The micro-laterolog minimizes the effects of mud cake, so giving the resistivity of the invaded zone near the well wall. From this the formation factor and then the porosity may be obtained. G. D. H.

790. The S.P. curve and the conventional resistivity curves. M. Martin. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1347–51.—The potential measured by the S.P. curve is usually largely due to electrochemical effects, electrofiltration giving only a small component. The value recorded depends on the bed thickness, and for beds several m thick is practically numerically equal to the total potential. The curve is used for correlation, and to select permeable zones, and $E_c = K \log_{10} \frac{R_{mf}}{R_w}$, E_c being the electrochemical potential, R_{mf} the resistivity of the mud filtrate, R_w the resistivity of the interstitial water, and K is *ca* 75 when the salinity of the interstitial water is mainly due to NaCl. The relationship gives an approx value for R_w in the absence of direct measurements on water samples.

Several different electrode arrangements or spacings give apparent resistivities. The values depend on the spacing, bed thickness, hole size relative to spacing, degree of invasion, and the real resistivity of the bed and its neighbouring beds. Under certain circumstances a good value for the true resistivity of the bed can be obtained. Special electrode arrangements are used for highly resistant beds, such as some limestone, because they are generally deeply invaded. The long normal or inverse curve after correction via departure curves may give the true resistivity. G. D. H.

791. Review of methods of measuring radio-activity in wells. R. E. Bush and J. C. Stick. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1352–60.—Radio-activity measurements in wells were introduced *ca* 14 years ago. At first they served to distinguish clayey from non-clayey beds by the natural radio-activity. In 1942 the neutron log came into use, and recently the neutron–neutron technique has appeared. They are used for correlation, determination of porosity and gas–liq contacts, detection of cased-off productive zones, for detecting cement by tracers, points of lost circulation, determination of injection profiles, and points where formation fracturing has occurred. The various operations are briefly described, together with the advantages and limitations of the techniques, and some possible new developments. G. D. H.

792. Methods of electrical diagraphy using micro-sondes. H. G. Doll. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1361–9.—The micrologs use closely-spaced electrodes mounted in an insulated pad which is pressed against the well walls. The micro-inverse and micro-normal systems have spacings of

2 and 5 cm respectively. The readings are affected mainly by the mud cake and the rock close to the well wall, and when the latter is permeable it will have been invaded by mud filtrate. Permeable beds may be detected by the separation of the 2 curves, but the permeability may vary widely, and in some cases the beds may be non-productive.

The effects of compact beds, clays, and cavities are described together with the determination of the formation factor and the porosity, measurements of the latter being possible when the values exceed 15%.

The micro-laterolog has concentric electrodes mounted in a pad to give focusing, and its depth of investigation is *ca* 7·5 cm. The effect of the mud cake is generally reduced in this device, which therefore gives a good value for the resistivity of the invaded zone. It has been used in hard formations where the mud cake is sufficiently thin, and can be employed with highly saline muds. Its application is described for porous and hard beds, and in clays. By association with other types of logs the interpretations are much improved. G. D. H.

793. Systems focusing currents. R. H. Winn. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1370–82.—Both the guard electrode system and the laterolog focus the measuring current, and are employed when muds are highly saline, the objective beds are very thin, or zones of high resistivity occur in the middle of potential producing rocks. Under these conditions focused currents give the best measures of true resistivity, and permit good correlation. Combination with radio-activity logs is helpful. γ-ray logs distinguish clayey beds, neutron logs yield porosity, and the guard electrode gives true resistivity and water saturation.

An example of the use of a combination of logs to derive reservoir data is discussed in some detail.

The true resistivity cannot be accurately determined when the resistivity of the invaded zone is high in comparison. G. D. H.

794. Laterolog. H. G. Doll. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1383–7.—The laterolog has electrodes so arranged that the measuring current is focused approx as a sheet, and may consist of a point electrode with 6 aux electrodes arranged symmetrically above and below, or of an elongated electrode with longer electrodes above and below. The mud column has little effect on the readings. Thin beds are clearly delimited, and a fair value for the resistivity is obtained, especially when high salinity muds are used. Adjacent beds have less influence than in conventional logging systems. However, to reach non-invaded rock the current is obliged to pass through the invaded zone, and this is serious in hard rocks, since the invasion is generally large.

All things considered, the best mud resistivity is 3–5 times that of the formation water, for too low values make the S.P. curve featureless. The principal use of the laterolog is in hard rocks. When fresh muds are used the microlog is a useful aux curve, and in very saline muds the γ-ray and micro-laterologs may be required. G. D. H.

795. Induction logs. H. G. Doll. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1388–92.—The induction log has an emitting coil energized by a.c. and a receiving coil. Focusing coils may also be used to reduce some effects due to the mud and beds opposite certain parts of the device. Induction logs can be used with non-conducting muds; they give sharp boundaries for the beds; in sands and clays when the beds are not less than 1·5 m thick and not deeply invaded, induction logs give a good indication of the true resistivity. Good definition is possible with beds as thin as 0·6 m, and the logs give detail when the resistivities are low. When invasion exceeds *ca* twice the well dia, corrections are needed to give true resistivities. The technique is most satisfactory when the resistivity of the invaded zone exceeds that of the formation. For the best results the mud resistivity should be at least 10 times the resistivity of the formation waters. Induction logs are made only occasionally in hard rocks, but it is thought that they will prove very valuable when equipment with a large radius of investigation is available. The best results may be obtained when there are supplementary logs. G. D. H.

796. Dipmeters. P. de Chambrier and R. L. Madden. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1393–7.—In recent years formation dips in wells have been determined using self-potential, resistivity, or microlog techniques involving 3 measurements spaced at 120° and with contact with the well walls. Self-potential measurements may not be applicable in some formations, but there may be usable resistivity differences. In order to interpret the measurements there must be associated observations on the inclination of the well. 3 simultaneous measurements of hole dia can also give dips.

The data are valuable in structural studies, and in detecting unconformities and faults under certain circumstances. Such studies aid in the better location of future wells. G. D. H.

797. New developments in radio-activity diagraphy. H. E. Shaller. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1398–401.—Radio-activity measurements in wells have been done on a commercial scale since 1940. At first an ionization chamber and Geiger counter were used, but in 1950 the scintillometer was introduced. The γ-ray and neutron measurements enabled a distinction to be made between limestones and pure sandstones, and rocks containing clay. Correlation by this means was possible in old wells which had not been electrically logged. Combinations of the logs made it possible to select the more porous intervals in limestones. With the scintillometer it is now possible to detect beds as thin as 30 cm. Stability and other features allow logs to be made when running in (often at 50 m/min), and then at a slower rate with more detail when pulling out. The scintillometer diagrams are more repeatable than the Geiger counter logs, and formations are detected more precisely. Families of neutron curves may be recorded. The intensity of neutron sources must be kept below harmful levels. Well size, spacing of source and detector, and invasion affect the results.

Radium–beryllium mixtures have been used, and more recently polonium–beryllium, which give a more favourable γ-ray–neutron ratio.

Tracers used in conjunction with spectroscopic techniques may improve certain data on fluid movements. The amount of aluminium in the formations can be determined. G. D. H.

798. Neutron–neutron method. J. H. Castel. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1402–5.—The neutron–neutron technique measures slow neutrons, which are essentially proportional to the amount of hydrogen in the formation, and does not measure either secondary or primary γ-rays. In a rock with much oil or water the high energy neutrons from the source are rapidly slowed and only a small number reach the counter, giving a feeble response. The device can be used in open or in cased holes. Porous zones in limestones can be detected. At times gas–oil contacts can be located because the gas zone frequently gives a stronger response. By calibration based on lab measurements of porosity, neutron–neutron determination of subsurface porosity is possible, there being an almost linear relationship between porosity and neutron flux. The measurements are relatively independent of rock density because secondary γ-rays are not involved. Radio-active markers and tracers do not affect the measurements. Surface calibration is possible in a large plastic cyl containing a known amount of hydrogen. Salt in mud can influence the propagation of neutrons, but the calibration permits correction for this. Variations in hole dia can be allowed for. The presence of clays in sands disturbs the porosity measurements. Association with a γ-ray log is essential. Future developments may permit certain other elements to be detected by logging. G. D. H.

799. Some conclusions on the use of electric and radio-activity diagraphy. M. Martin. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1406–14.—Electric and radio-activity logs are used to delimit formations, and thereby to define structure and to

detect porous and permeable sectors. The porosity and fluid content can at times be estimated. The factors affecting the various measurements are reviewed, and there are summaries of what can be done in various types of formation, and favourable conditions for the application of certain techniques are indicated.

The max oil producible by efficient water drive may be indicated by the amount of residual oil in the invaded zone.

G. D. H.

800. Deviation measurements in wells. G. Jackson. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1415–19.—The earliest measurements used acid bottles, and these were followed by compasses floating in gelatine which solidified and gave both deviation and direction of deviation. Photographic recording of a magnetic needle and pendulum followed, and the devices were made as small as 25–38 mm dia. Gyroscopic compasses were used in cased holes. Multiple shot devices are available, which are actuated in various ways, some giving a double reading as a check that a stationary condition had been reached. Some can be used inside drill-pipe, non-magnetic drill collars being employed with magnetic devices. A surveying method involving recording of any rotation of the drill-pipe has been used. Inclinations can now be read to 15′ and directions to 1°, and it is possible even with 3000 m drift to place the bottom of the well within a radius of 15 m.

A knowledge of the path of a well is useful in ensuring suitable subsurface spacing, and no transgression of concession boundaries; it may help if there is a blow-out and a relief well is needed. Intentionally deviated holes may be drilled for various reasons. Side-tracking may be helped, and some pumping troubles avoided by executing deviation surveys.

G. D. H.

801. Mud logging. R. W. Wilson. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1420–2.—Mud logging detects oil and gas in the mud or cuttings, gives lithological descriptions of cuttings, uses drilling speed as a possible measure, but for variety of reasons the quantitative data are not precise. Feeble indications may be given by highly productive horizons, and vice versa. Experience has shown that methane is present in all commercially-productive horizons of oil or gas, and hence if no methane is detected, even though oil or heavy gases are recorded, the horizon is probably non-productive. Very slow drilling or coring or high mud pressures giving much filtrate may lead to no mud logging indications. Loose sands and debris from diamond drilling afford no analytical data via cuttings.

Mud logging supplements data obtained by other means. It is direct, and does not usually hold up drilling. It requires trained personnel continually in attendance and is comparatively costly. If gas enters the mud from long gas-bearing sections it can be troublesome in the detection of methane, and the same is true of hydrogen formed by corrosion of casing or drill-pipe.

G. D. H.

802. Caliper logging. R. H. Winn. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1438–42.—Caliper logging is especially useful in regions where there are difficult cementing problems. Washouts and corrosive waters create these problems. The logs when used in association with other logs may aid lithological determinations and location of porous horizons. Groups of curves illustrating these uses are given. Careful selection of points for setting packers may be necessary to segregate thin beds for testing.

Recently cavities have been made by dissolving salt in domes to provide storage for gas and petrol. Conventional caliper logs are limited to radii of 40 cm. A sonic device has been made which will measure accurately radii of 1·5–60 m. Pulses are emitted which fan over 9° vertical angle and 75° horizontal angle.

G. D. H.

803. Temperature surveys. M. P. Tixier. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1446–8.—If measurements are made in mud a few hours after stopping circulation, they will be much affected by the amounts of mud at each level. Hence the temp log may show affinities with caliper surveys. Temp measurements at an appropriate time after cementing will show the top of the cement and points where the hole is enlarged, because of the heat evolved.

Measurements in gas wells show the point of entry of the gas because of cooling arising from gas expansion. The cooling is dependent on the pressure drop rather than on the rate of flow. The temp curve above the point of entry is exponential, and the sub-tangent to the asymptote is proportional to the quantity of gas entering.

Temp surveys in oil wells reveal points of entry via the cooling effect of gas evolution, or points of entry of gas or water. Points of lost circulation may be detected by pumping mud into the hole rapidly, and then a temp survey shows a slight rise in the undisturbed mud immediately below the point of lost circulation.

G. D. H.

804. Lost circulation detection. F. Pehovshek and R. Q. Fields. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1449–50.—A soln of NaCl to which sugar has been added to make it the same density as the mud and with ½ the mud resistivity is contained in a cyl from which a small quantity can be released by operating a solenoid-controlled valve. 1 m above the orifices and 1 m below are pairs of electrodes 3 cm apart. Each pair forms an arm of a Wheatstone bridge fed by a.c. In the tests the device is stopped at the point of interest, the bridge is balanced, and *ca* 80 cc of the soln is ejected. If liq is ascending in the well the soln will rise with it and reduce the resistivity measured by the upper pair of electrodes; if it is descending the reverse will happen. The speed of movement can be obtained by timing. If there is no reaction in 5 minutes the flow is assumed to be zero. Confirmation of the latter point may be obtained by slowly raising or lowering the device 1 m. By putting the device at successive levels the point of loss can be obtained. Usually the driller has a general idea of where the loss is occurring. The well must be kept full during the test to keep conditions constant.

If mud resistivity is below 1 Ω m²/m the effect is too small for detection. The device does not work in dense muds or in oil-base muds. Out of 28 tests in California, 14 were successful. Under favourable conditions the point of loss can be obtained to 1·5 m.

G. D. H.

805. Sidewall coring. R. Q. Fields and M. Lebourg. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1451–2.—Sidewall coring by shooting hollow cyl into the formations began in 1935, and can now be used in both hard and soft beds. Standard equipment is for 6, 18, and 30 shots. The dia are up to 19 or 30 mm, and lengths of 57 mm. It is run on electric logging cable. The shots are fired separately, at points located from a previous S.P. log by means of an S.P. device. The bullets are pulled out of the rock by applying tension, and the links break if the bullets are too tightly embedded. Overall recovery averages 70%. The newer devices give cores sufficiently large for porosity and permeability studies. Palæontological and other studies can be made.

G. D. H.

806. Deep Lacq: a gas reservoir with exceptionally high pressure: drilling problems. Y. Berger. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1453–66.—Deep Lacq produces from Neocomian limestones and dolomites, the highest part of which is at 3350 m. They have been tested over an interval of 1000 m. The gas contains 17% H_2S, 8% CO_2, and 1 m³ gasoline/50,000 m³ gas. Rock porosity is 2–3%, and locally 10%; the matrix permeability is 0·1 mD, but there are extensive fractures. At the highest point in the reservoir the pressure is 645 kg/cm²; the rock load is *ca* 745 kg/cm². Natural fissures are 1 mm–1 cm wide, and filled with calcite; only rarely have open fissures been seen. Induced fissures have been noted in cores, and the theory underlying artificial fracture formation is considered. Some experimental results are also given, and it is noted that fracturing occurs at pressures near to rock load. Some relation between pressure values and fracture orientation has been noted, but the rock characteristics may also be involved.

In drilling at Lacq gas escape has to be combated, and at the same time lost circulation needs to be avoided. The latter may take place along natural fractures, or along those induced by pressure. Loss may be sudden and complete, with a risk of blow-out. Often loss follows a phase of super-pressure, for the weight of the mud column plus the circulating pressure is not far from the formation fracturing pressure. Running of drill-pipe at high speed may cause super-pressure, and this will depend on pipe size and length, as well as on mud properties. Rapid pulling out gives a swabbing action. Slow starting of pumps may reduce super-pressure effects. G. D. H.

PRODUCTION

807. Let geology help your fracturing. R. C. Clark and R. G. Loper. *Oil Gas J.*, 13.2.56, **54** (41), 130.—Calculations of estimated production increase by hydraulic fracturing have been based on the radial form of Darcy's law, which gives an estimated increase of ×3. Proved increases have, however, been ×10 to ×100, and this is believed to be due to the formation by fracturing of permeable channels through a plugged zone around the well bore.

A knowledge of the depth of fracturing required to penetrate this zone is of economic importance, and recent theoretical and lab studies, which are briefly described, can help to solve this problem. C. A. F.

808. How to use core analysis to find oil. B. A. Elmdale. *Oil Gas J.*, 27.2.56, **54** (43), 104.—The fluid mechanics of coring are described, and 2 principles that require consideration in the interpretation of data are emphasized: (1) flushing of the core by the drilling fluid filtrate, and (2) expansion of gas in the pores as the core is brought to the surface. Cores are seldom unflushed, and the degree of flushing is a function of rate of bit penetration, permeability, drilling fluid flow and core dia, visc and compressibility of reservoir fluids, and mud weight and water loss. The effect of each of these factors is briefly considered.

The amount of oil retained after flushing and core removal is determined by the visc of the reservoir oil and the shrinkage factor. Permeability and porosity limits and oil and water saturation limits for various reservoirs of the Gulf Coast area are tabulated. C. A. F.

809. Practical method for treating oilfield interference in water drive reservoirs. M. Mortada. *J. Petrol. Tech.*, 1955, **7** (12), AIMME Tech Paper No. 4180, 217–26.—Analogue and digital computers are not always available, and hence analytical methods of dealing with oilfield interference problems are valuable. The present method employs the principle of the superposition of individual effects, and a series of charts has been developed to evaluate the individual effects. The charts represent non-steady state pressure distribution in an extensive aquifer due to a constant flow from an approx circular field, and were obtained partly analytically and partly by analogue and digital computations.

Using the method of images, the charts can be employed for production near a fault, while modifications are possible for cases of partial water drive. G. D. H.

810. Analogue computer for studying heat transfer during a thermal recovery process. L. C. Vogel and R. F. Krueger. *J. Petrol. Tech.*, 1955, **7** (12), AIMME Tech Paper No. 4181, 205–12.—An electrical analogue computer is described which is suitable for solving non-steady-state heat transfer problems for a moving cyl source in an extensive homogeneous radial formation. It is applied to a simplified oil recovery process using a constant temp moving source with radial heat transfer by conduction. Curves show temp distribution ahead of the front for different rates of movement of the source and for different positions of the source. The data are used to estimate the residual fuel needs for maintaining a self-propagating isothermal front for various rates of movement and conductivities.

Since the computer takes note only of heat losses by radial conduction, the data do not apply directly to field operations. Modifications may be possible to cover other heat transfer mechanisms if the mechanism is clearly defined, and such definition may be aided by lab scale model studies. G. D. H.

811. Displacement logging in a new exploratory test. W. M. Cambell and J. L. Martin. *J. Petrol. Tech.*, 1955, **7** (12), AIMME Tech Paper No. 4178, 233–8.—When filtrate invades an oil-bearing zone it will displace the oil, and also to some extent displace low-resistivity connate water as a bank separating oil from filtrate, and so giving a low resistivity zone between 2 zones of higher resistivity. The former may be capable of being detected by a group of resistivity surveys by different suitable electrode spacings, the low resistivity indication being fixed in position.

The existence of this phenomenon has been confirmed by lab and field studies. Several of the latter are reported. A logging device and techniques capable of detecting this feature are described. Various improvements are under consideration. G. D. H.

812. Measurements of permeability in wells. P. E. Fitzgerald and S. J. Martinez. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1423–9.—The techniques give curves which are in indication of the relative values of the permeability at different depths. The results are valuable in selective acidization and perforation; they indicate the effectiveness of various treatments for stimulating production; they assist in secondary recovery work and in detection of zones of lost circulation. The methods make use of mobile liq interfaces, static interfaces, or the rate of fluid flow. In the first case liq is injected at a constant rate, and the interface is tracked by using electrodes, with one liq a conductor. Alternatively, a photo-electric cell may be used with fluids of different opacities. If one liq is injected through tubing and the other in the annulus, the ratios being controlled, a static interface results, and can be used with other information to detect fluid exit.

Spinner surveys reveal the fluid movement at different depths for fixed rates of injection, and so show how the fluid is entering the formations. Hot-wire anemometers have also been used.

The data give the capacity (rate of fluid entry), capacity index (rate for unit pressure difference), and specific capacity index (capacity index–thickness). These factors may be a measure of the effectiveness of various operations.

The most suitable method will depend on the conditions, and whether there are serious objections to forcing water into the formations.

Recently radio-active epds have been used to give detectable interfaces, means of measuring velocities, or in particulate form for showing zones taking fluid by radio-activity surveys made before and after the treatment. G. D. H.

813. Permeability determinations in wells. M. P. Tixier. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1430–2.—Microlog measurements by taking note of filter cake give a qualitative indication of permeability, and this may be improved by local knowledge. For logs through beds with hydrocarbons in the upper part and water at the base of the sand the resistivity gradient divided by the resistivity in the watered section has been used to get the mean permeability when the densities of the fluids are known. This approach has given reasonable values on many occasions, and has proved valuable in exploratory wells.

In 1950 it was decided on the basis of theoretical studies that the order of magnitude of the permeability could be obtained by $K^{\frac{1}{2}} = c\phi/S_w$, where K is permeability in mD, ϕ porosity, S_w irreducible water saturation, and c a constant. In Oklahoma this relationship has given reasonable values when $c = 10$. It was shown that $c = 10\left(\frac{\phi}{2}\right)^2$. G. D. H.

814. Pressure measurements in wells. C. H. Danchertsen. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1436–7.—The earliest attempts at obtaining reservoir pressures were made by

adding to the surface pressure the wt of a column of gas or of liq. This was reasonably accurate for static conditions in wells giving only oil. Difficulties arose when there was flow or production of oil and water. In 1927 well pressure was obtained by means of manometers. One type recovered a sample of fluid from the bottom of the well at subsurface pressure, and the pressure on the fluid was measured. The other type was a steel vessel with one or more max manometers. Then recording manometers were introduced. These used pistons or diaphragms, or the Bourdon spiral.

In 1940 an acoustic method (echometer) was introduced for getting fluid levels in wells. Tubing collars also gave reflections, and counting these gives the depth to the liq. Via this information the reservoir pressure is obtainable if the liq density is known. This method is used mainly on producing wells, and avoids pulling the rods.

Pressure data may be used in reserve calculations, designing equipment, to obtain permeability and the productivity index, to decide on spacing and reservoir control.

Devices which record at the surface will offer definite advantages. G. D. H.

815. Determination of points of water entry. W. W. Ennis. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1443–5.—In order to detect points of water entry it is necessary to lower the fluid level in the well to such a point that the water is able to flow. In the electrochem method plates of 2 different metals are lowered on the end of a cable. A measurable contact potential is set up, and this varies with the composition, but not with the concn of the electrolyte. A small amount of chemical is used for conditioning the fluid in the well, and this is introduced by a device lowered with the plates. There must be water in the sector to be tested. Passage of oil or gas through the treated sector does not upset readings unless it mixes inflowing water with that treated. A voltage change occurs at the point of influx, and the device can also be used to give a measure of the rate of influx.

In the photo-electric method a dye is added, and this cuts out light passing from one part of the device to the photo-electric cell. A little dye suffices for a long sector of the well. A change of intensity will occur at the point of influx. Oil is opaque and may be confused with dye-treated water.

Each method has its own advantages.

A device measuring impedance can be used to locate water and oil in the well, and oil entry points. G. D. H.

816. Oklahoma's fractured Viola limestone reservoir. E. Skarda. *Oil Gas J.*, 27.2.56, **54** (43), 109.—Reservoir evaluation of the Viola limestone in the Bayou area in S. Oklahoma is described. Production is from a fracture zone in the truncated edge of the limestone beneath the unconformity at the base of the Pennsylvanian. Production is controlled entirely by the fracture system, which is very complex, and conventional log methods of evaluation have proved of little value. A method of gas drilling has been developed which has increased penetration rates and enabled the formation to be continually tested, as hole pressures are generally less than atm. Radio-active krypton has been used as a tracer to study oil in place. C. A. F.

OILFIELD DEVELOPMENT

817. Santa Fe Springs gets new life at 37. Anon. *Oil Gas J.*, 5.3.56, **54** (44), 66.—A new pay between 8050 and 9010 ft has been found in the Santa Fe Springs field, Los Angeles; the discovery, 243 Santa Fe, produced 1776 b.d. of 30·9° oil. Previous deepest production was from the Hathaway at 7950 ft. Oilfield development at Santa Fe Springs since its discovery in 1919 is outlined briefly. C. A. F.

818. Frustration and faith in New Guinea. Anon. *Petrol. Press Serv.*, 1956, **23**, 84–6.—Despite a very big deficit and disappointingly small discoveries after 20 years' work, the Dutch New Guinea Petroleum Co has applied for a very large extension of its present concession in W. New Guinea and proposes to embark on a fresh programme of arduous and expensive exploration in this very difficult territory, where it has already contributed much to native welfare. (Author's abstract.)

TRANSPORT AND STORAGE

819. Standardization of buried ferro-concrete tanks for crude and for petroleum products. V. A. Bunchuk. *Neft. Khoz.*, 1956, (3), 50–4.—Range covered 100–20,000 m^3: 100–1000 m^3 round, 2000 and 3000 m^3 round or rectangular, >5000 m^3 rectangular. Normal depth 5–6 m, with up to 10 m for larger tanks in suitable circumstances. Earth overburden >0·2 m, roof loading 250 kg/m^2. For such tank evap loss is *ca* 10% of that for the conventional above-ground metallic tank. Construction can be of pre-stressed concrete panels, steel covered. V. B.

820. New methods for checking weld quality in tanks and pipelines. A. S. Fal'kevich. *Neft. Khoz.*, 1956, (1), 64–71.—Brief discussion of use of radio-active isotopes (mainly Co^{60}), magnetic, and ultra-sonic methods, with mention of U.S.S.R. test equipment. V. B.

821. Use of automatic protective devices on trunk pipelines. V. D. Belousov, L. Ya. Tsikerman, and S. A. Bobrovskii. *Neft. Khoz.*, 1956, (2), 54–60.—Discussion of principles governing operation of max flow alarm (suitable for centrifugal pumps only), min flow alarm (for any type of pump), and differential alarm giving protection against fault within restricted section of line. V. B.

822. Stripper plant boosts pipeline efficiency. A. W. Rifenburg. *Oil Gas J.*, 5.3.56, **54** (44), 97.—The Mississippi River Fuel Corpn installed a liq-removal plant which paid for itself in 3½ years from sale of removed liq and at same time increased pipeline efficiency from 76 to 92%. G. A. C.

823. Hydraulics for pipeliners. Pt XVII. C. B. Lester. *Pipe Line News*, 1956, **28** (1), 34–41.—The design and operating characteristics of rotary and centrifugal pumps and the methods of calculating pump performance are given. B. A. F.

824. Piping bridge replaces underground storage. E. C. Fitzgerald. *Oil Gas J.*, 26.3.56, **54** (47), 117.—The original piping system at the Baltimore refinery of Esso Standard Oil Co has been replaced by an all-welded steel 3-span, 500-ft piping bridge system, linking the major crude and finished products storage area with the refinery's main processing area. G. A. C.

825. Magnetic-drum electronic computer is brain saver. H. E. Thomas. *Oil Gas J.*, 26.3.56, **54** (47), 136.—Electronic computers, although their initial programming takes more time than if calculations were done manually, eliminate many tedious and repetitive manual calculations, and once set up, parameters can be easily changed and performance of a line calculated in minutes. The procedure in using a computer is given. G. A. C.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

826. How to design barometric condensers. H. How. *Chem. Engng*, 1956, **63** (2), 174.—The uses of barometric condensers are discussed, and several types are described. The calculation of the size of a condenser is given in detail and the installation and operation described. D. J. S.

827. Proper design for painting. H. G. Kirtley and W. G. Colter. *Chem. Engng*, 1956, **63** (2), 187.—The initial design of many items is important if maintenance of protective coating is to be a low charge on a plant. Walls, windows, piping, pipe supports, and tanks are included in the discussion. D. J. S.

828. Submerged combustion flares anew. C. S. Cronan. *Chem. Engng*, 1956, **63** (2), 163.—The principles of submerged combustion are outlined. It is shown to have advantages in low first cost, low scaling, and high heat utilization. Several applications are described. D. J. S.

829. Help in designing pressure vessels. R. W. Schneider. *Chem. Engng*, 1956, **63** (2), 171.—The stresses in flat-headed pressure vessels are discussed, and a graphical method which simplifies design calculations is given with examples. D. J. S.

830. Making 100 octane fuel. Anon. *Oil Gas J.*, 19.3.56, **54** (46), 138.—Flow sheets and descriptions are given of 42 processes now in use or which may be adapted for the production of high octane motor fuel. Included are 6 cat cracking processes, 13 cat reforming methods, 7 hydrogen treating, 6 alkylation, and a number of other processes for special purposes. Typical operating data yields and economics are given. G. A. C.

831. A short description of the combined unit at Sisak. R. Budac and D. Lalic. *Nafta* (*Yugoslavia*), 1956, **7** (2), 47–50.—The new combined unit, with its Orthoflow cat cracker is described (*cf* Abs. **835**, 1956). (Authors' abstract.)

SOLVENT EXTRACTION AND DEWAXING

832. Correlation and practical application of results from laboratory and practice. K. Recovery of crude benzene. Practical part. W. Mantel and H. Hansen. *BrennstChemie*, 1956, **37** (3–4), 54–9.—The calculation is simplified for works use. Operational val are introduced into the equation, and sorption tech val for operating conditions are calc and entered in a diagram. Examples are given using simplified equation and diagrams. R. T.

CRACKING

833. How Union gets top octanes from two California plants. J. M. Deal. *Oil Gas J.*, 19.3.56, **54** (46), 195.—The processing of Santa Maria crude in the new Santa Maria refinery to produce straight-run cracked gasoline and gas oil dist, which are then shipped to the Oleum refinery is described. Combined stocks are processed in a combination Uniflow–Platformer unit, a cat desulphurization and reforming installation to produce 97(F-1 + 3 ml TEL) octane blending stock. G. A. C.

834. Light thermal cracking of bitumen from Devonian crude. S. V. Adel'son *et al.* *Neft. Khoz.*, 1956, (1), 54–8.—Vac residue (33–35%, *d* 0·981, asphaltenes 6·3%) cracked in 2-furnace operation to yield 11·5% stabilized gasoline (F.B.P. 165° C, iod. val. 97, O.N. 68) and 80·5% residue (*d* 1·00, asphaltenes 14·3%). Plant throughput 1625 tons/day, with runs of 30–40 days. For heavier residues single furnace working is recommended, using deep-cracking furnace for feed heating. V. B.

835. Fluid cat cracker of the Orthoflow type erected at Sisak. A. Mosic. *Nafta* (*Yugoslavia*), 1956, **7** (2), 39–47.—As central part of a new combination unit, a fluid cat cracker of the Orthoflow type has been erected at the Sisak refinery. The Orthoflow design was licensed by the M. W. Kellogg Co, New York, to Friedrich Uhde G.m.b.H., Dortmund, who engineered the whole unit. Features of the Orthoflow cat cracker, as well as some principles of the fluidized bed technique, are described. (Author's abstract.)

POLYMERIZATION

836. Polymerization of propene with a silicotungstic acid catalyst. Pt I. Batch experiments with unsupported catalyst. Pt II. Continuous experiments with the catalyst on carrier. J. J. Verstappen and H. I. Waterman. *J. Inst. Petrol.*, 1955, **41** (383), 343–51.—Batch experiments on the polymerization of propene are described. The unsupported cat was silicotungstic acid. 28% wt of tetramers was present in the liq polymers at 86% wt conversion under standard conditions. The structures of the polymers were investigated, using various methods. The results indicate that silicotungstic acid is a more specific cat for tetramer production than phosphoric acid.

Pt II tells that continuous polymerizations were carried out using bauxite as carrier for the cat. Products yielding 20–24% wt of tetramers were obtained using technical propane–propene feedstock (50% vol of propene). A once-through operation at 150°–180° C, pressure 80–120 atm, and space velocities between 0·22 and 0·54 U.S.G/hr/lb cat were the conditions used. Cat was 20% wt silicotungstic acid on bauxite. Up to 95% wt of the propene was converted. 18 literature refs are given. C. B.

CHEMICAL AND PHYSICAL REFINING

837. Description of the plant for desulphurization of refinery sour gases. D. Lalic. *Nafta* (*Yugoslavia*), 1945, **7** (2), 51–4.—Alkacid process for desulphurization of refinery sour gases in a plant designed by Friedrich Uhde G.m.b.H., Dortmund, as part of the combined unit for the Sisak refinery is described. (Author's abstract.)

SPECIAL PROCESSES

838. Ammonia manufactured by gas reforming. J. C. Reidel. *Oil Gas J.*, 26.3.56, **54** (47), 106.—A description is given of the 450 ton/day ammonia plant belonging to Phillips Chemical Co on Houston Ship Channel, where it processes natural gas to make hydrogen for ammonia synthesis. A feature is an improved high-temp radiant heater used in steam–methane reforming. G. A. C.

839. Synthesis of carboxylic acid by the addition of carbon monoxide and water to olefins. H. Koch. *Riv. Combust.*, 1956, **10** (2), 77–99.—The Max Planck Institut für Kohlenforschung at Mülheim-Ruhr has developed a new procedure for the synthesis of carboxyl acids by the addition of carbon monoxide and water to olefins. This method differs from those known heretofore by the particularly mild reaction conditions adopted, namely the low temp, preferably between 0° and 30° C, and relatively low pressure, generally from 20 to 100 atm. The procedure, which takes place in the presence of acid cat, is characterized by the fact that at the beginning the reaction with carbon monoxide occurs in the absence of water, and the necessary quantity thereof is added only subsequently. The cat used are principally conc sulphuric acid or blends of acids containing boron fluoride in complex bonds. The

carboxyl acids obtained by the new method of synthesis, mostly with very good yields, all contain a chain of branched carbon atoms with single or double branching to the carbon atom next to the carboxyl group. Suitable olefins to work on are widely available, since the process can be performed with either propylene and butylene from cracking gases, or with the long-chain olefins from high b.p. cracking dist, as well as with cyclic olefins. The reaction can also be very well performed with the well-known polymerization products of the tetramer propylene or the di- and tri-*iso*butylene type. The interesting starting products for this method also comprise oleic acid, from which an excellent yield of a dicarboxyl acid C_{19} can be obtained. From the experimental findings currently available it can be deduced that the products of the new synthesis of carboxyl acids offer interesting fields of use.
(Author's abstract.)

840. Motor fuel sweetening with cupric chloride. A. Mosic. *Nafta* (*Yugoslavia*), 1956, **7** (2), 54–8.—A description of the Linde copper sweetening process designed by Friedrich Uhde G.m.b.H., Dortmund, as part of the combination unit at the Sisak refinery. (Author's abstract.)

METERING AND CONTROL

841. Developments in instrumentation by the petrochemical industry. R. G. Marvin, W. L. Stuart, G. W. Lunsford, and E. E. Ludwig. *Mech. Engng, N.Y.*, 1956, **78** (2), 132.—Aspects considered are: relative flow measurement at high pressure, ratio flow control of 2 gas streams in a process, use of a strain cell for pressure control, control of an absorption refrigeration system, the sealed meter, and flow measurement for high pressure gas streams. D. K.

PRODUCTS

CHEMISTRY AND PHYSICS

842. Chemical engineering fundamentals—reactor design for complex reactions—II. T. E. Corrigan and E. F. Young. *Chem. Engng*, 1956, **63** (2), 193.—The methods for selection of a reactor for a complex series reaction are discussed. The effect of added reactants, reactant ratio, and back-mixing is to complicate the kinetics, and methods of solution are given.
D. J. S.

843. Plot vapour–liquid equilibrium diagrams faster. N. N. Buchsbaum. *Chem. Engng*, 1956, **63** (2), 169.—A chart has been developed to speed up the plotting of vapour–liq equilibrium curves for binary mixtures. It permits construction of the curve, without calculation, from relative volatilities; details are given of the method of using the chart, and an example is given. Changes in relative volatility are accounted for.
D. J. S.

844. Short cuts for transient heat flow. I. Granet and R. M. Gould. *Chem. Engng*, 1956, **63** (2), 183.—Extreme reaction conditions mean that operations now approach the temp limits for materials of construction. The solution of problems in unsteady state conduction is discussed, and 5 methods of solution are given. D. J. S.

845. Survey on obtaining the data for equilibrium flash vaporization of petroleum mixtures. M. Maretic. *Nafta* (*Yugoslavia*), 1956, **7** (1), 17–22.—The best-known methods of calculation from ASTM or TBP dist curves, together with the lab apparatus for experimental determination of data, are discussed. (Author's abstract.)

ANALYSIS AND TESTING

846. A qualitative test for TEL in gasoline. G. E. Mapstone. *J. Inst. Petrol.*, 1956, **42** (386), 67.—The test is based on the precipitation of PbS after decomposition of TEL. It is sensitive to between 0·01 and 0·02 ml/gal TEL/I.G. C. B.

847. Tentative standard method for the assessment of the rust preventing characteristics of hard film and soft film temporary corrosion preventives. Protectives Panel of IP Standardization Committee No. 6. *J. Inst. Petrol.*, 1956, **42** (386), 50–4.—The standard (IP 153/56T) permits assessment of rust prevention characteristics. It is not suitable for oil-type protectives. Results of exposures of test panels which were carried out in 6 lab are correlated and compared with results of a field test. 3 literature refs are included. C. B.

848. Precision of fuel rating 1947 to 1953. R. A. Gooding and R. B. Cleaton. *Bull. Amer. Soc. Test. Mat.*, Jan. 1955, (203), 51–61.—The history of the organization for co-operative rating of motor, aviation, and diesel fuels is briefly surveyed, and the methods of rating employed, together with the method of calculating the precision of results so obtained, are described. Results over the past 5 years are discussed, and show increased precision as compared with those of past 7 years. J. G. H.

849. Sampling diesel locomotive lubricating oil for spectrographic analysis: Report from Research Division III on Elemental Analysis. ASTM Committee D-2 on Petroleum Products and Lubricants. *Bull. Amer. Soc. Test. Mat.*, Sept. 1955, (208), 24.—Detailed procedures are presented for the obtaining of lub oil samples from diesel locomotives for spectrographic analysis by means of a sampling gun or a sampling cock, and essential minimum data to be provided with each sample are enumerated. J. G. H.

850. Classification of industrial lubricants. G. D. Jordan. *Sci. Lubric.*, 1955, **7** (12), 13–19.—Trends towards standardization and simplification as contributions towards increased productivity are noted, and applications to industrial lubrication are considered from the standpoints of rationalization, classification by application, and by specification. Advantages obtaining from reduction in number of lubricants carried are noted, and cases calling for compromise are indicated. SAE, NLGI, and BS specifications for oils and greases are discussed, and benefits to be derived from classification of lubricants are enumerated. J. G. H.

851. Photometric evaluation of detergency of lubricating oils. J. Faust. *Lubric. Engng*, Nov. 1954, **10** (6), 345–9.—Previous attempts to develop a satisfactory test for the detergency of lub oils are reviewed, and details are presented of a new method which determines photometrically the amount of carbon black remaining suspended in an oil, the figure so obtained being designated the "Detergency Index." Procedures and results obtained are discussed in detail, good correlation with engine tests and other additive rating methods being obtained. Method is rapid, calls for little special equipment, and gives good reproducibility. J. G. H.

852. Design and use of the Shell Roll Test. J. D. Smith. *NLGI Spokesm.*, Nov. 1955, **19** (8), 8–10.—Details are presented of the development of the Shell Roll Test equipment intended for the measurement of shear stability of greases. The current model is described, and procedure employed in its operation is explained. J. G. H.

853. Effect of streamlining of stresses in the Perkins tensile strength briquet for refined paraffin waxes. W. P. Ridenour and J. R. Bowman. *Bull. Amer. Soc. Test. Mat.*, Sept. 1955, (208), 48–9.—A reprint of article with same title which appeared in July issue, with an additional dimensional drawing of the modified wax mould. J. G. H.

854. Field reproducibility of the asphalt penetration test. L. W. Corbett. *Bull. Amer. Soc. Test. Mat.*, May 1955, (206), 63–4.—While the test for penetration of bituminous materials (ASTM D5–52) as applied to asphalt cements has been found

to be reproducible within reasonable degrees in temporary field lab, variations have been encountered which called for explanation. The normal course of inspection and approval of some 3000 shipments of asphalt cement for use on the Garden State Parkway in New Jersey in 1954 provided an opportunity for investigation of these variations, and details of the procedure employed are presented. From the data so collected it was concluded that variations were primarily due to measurement errors, with smaller variation effects due to sampling techniques, the asphalt itself, or both. J. G. H.

ENGINE FUELS

855. Preflame reactions in diesel engines. Pt III. F. H. Garner, G. H. Grigg, F. Morton, and W. D. Reid. *J. Inst. Petrol.*, 1956, **42** (387), 69–94.—An investigation of preflame occurrence in diesel engines was carried out using a photomultiplier unit. An electromagnetically operated mushroom-type sampling valve was designed to withdraw samples of combustion chamber gases and hence follow the chemical preflame reactions. The preflames were dependent on fuel composition, injection timing, and engine conditions, and were accompanied by high concn of aldehydes. 2 types of preflames have been observed, one of high intensity occurring before fuel injection, and one of low intensity occurring at or after injection. With both early and late injection timings a high Cetane No. paraffinic fuel gave low intensity preflames at or after injection, but a low Cetane No. naphthenic fuel gave high intensity preflames before injection with late injection timing. These were suspected of being characteristic of low Cetane No. fuels and were believed to be due to unburnt charge from the previous cycle. Oxidn mechanisms in diesel engines were discussed. 21 literature refs, 7 pages of discussion, and several photographs and diagrams are given. C. B.

856. Boron compound lifts motor-fuel octane. E. C. Hughes, P. S. Fay, and W. T. Wofring. *Oil Gas J.*, 26.3.56, **54** (47), 121.—A boron component, a low visc liq easily added to gasoline, is shown to effectively reduce surface ignition in gasoline engines, increase F-1 anti-knock effect of TEL, and counteract in part bad effect of sulphur cpds on TEL. G. A. C.

857. The vapour pressure of alcohol–gasoline blends. G. E. Mapstone. *J. Inst. Petrol.*, 1956, **42** (387), 95–6.—The increase of vapour pressure with temp of alcohol–gasoline blends was determined and found to be similar to that for alcohol-free gasolines. Nomographs for the calculation of the effect of temp on the v.p. of gasolines, and for the Reid v.p. bomb correction were given. The modification of the Reid method (ASTM D323–52, IP 69/55) by the use of dry equipment necessitated this correction. The formation of azeotropes was discussed. 3 literature refs. C. B.

858. Using turbine fuels at low temperatures. H. Strawson. *Shell Aviation News*, Dec. 1955, (210), 8.—Discusses the criteria of fl. pt., pour point, and pumpability, and describes experiments carried out at Thornton Research Centre on the low temp behaviour of kerosine fuels. Although the coldest operating temp likely to be met are below the D.Eng.R.D.2482 specification fl. pt. temp, the author suggests that a kerosine meeting this specification could be used in conjunction with tank insulation or heating, or mechanical agitation of fuel. These methods involve weight and mechanical complications, and it is suggested that, compromising between fuel availability and operational requirements, fuel of a −50° C pour point should be used. C. B.

GAS OIL AND FUEL OIL

859. Railroads shop at the bargain counter. W. T. Robinson. *Oil Gas J.*, 20.2.56, **54** (26), 104.—Since there is not enough premium diesel fuel to go round, U.S. railroads are using lower quality or economy diesel fuels. Instability can be overcome by using non-metallic additives, which latter also reduce sparking problems. G. A. C.

LUBRICANTS

860. Miles per quart +. 1. J. M. Nuttall. *Sci. Lubric.*, 1955, **7** (12), 26–30.—The place of lubrication in ensuring the smooth running of the modern automobile is remarked, and the distinguishing characteristics of the main types of crude oil are pointed out. Methods of treating and basic properties of lub oils are discussed, together with the mechanics of lubrication. J. G. H.

861. Bearing materials. A. F. Brewer. *Lubric. Engng*, Nov. 1954, **10** (6), 313–18.—Metallic and non-metallic materials for bearings are surveyed, and their characteristics, advantages, limitations, and lubrication requirements are discussed. Bases for the selection of bearing materials for individual applications are indicated. J. G. H.

862. Canada's newest grease plant. R. O. Rinearson. *NLGI Spokesm.*, June 1955, **19** (3), 8–13.—British American Oil Co's new grease plant with a capacity of 15,000,000 lb/year is described and illustrated. J. G. H.

863. Recent advances in the hydrodynamic theory of slider-bearing lubrication. F. Osterle and E. Saibel. *Lubric. Engng*, May 1955, **11** (3), 187–92.—Recent contributions to the hydrodynamic theory of lubrication made by present authors in a series of papers in *ASME Trans.* under the general title "On the Solution of the Reynolds Equation for Slider-bearing Lubrication" during the period 1952–54 are summarized. J. G. H.

864. Taxicab engine wear and cleanliness. O. W. Wuerz. *Lubric. Engng*, Nov. 1954, **10** (6), 319–26.—Fleet tests in New York with 1600–2000 taxicabs over a period of 20 years are reported. While straight mineral oils were originally used, high additive lubricants were employed in the last few years, showing marked improvements in operating conditions. From a detailed discussion of the results it appears that frictional and abrasive cyl wear is of minor consequence as contrasted with corrosive wear. The later use of Supplement 1 oil resulted in top cyl wear being reduced to a degree where ring life was doubled, sludge deposition was practically eliminated, manual cleaning was no longer necessary, and maintenance costs were reduced. J. G. H.

865. Frictional properties of soaps at high pressures. J. R. White. *Lubric. Engng*, Nov. 1954, **10** (6), 340–4.—While the lub properties of additive-containing oils and straight mineral oils have been the subject of much study, those of soaps alone have received little consideration. The mechanism of boundary lubrication with soap-containing lubricants is outlined, and measurements of shear strength properties of even-carbon-numbered fatty-acid soaps from C_4 to C_{18} at 4 pressures in the range 30,000–250,000 p.s.i. and at temp of 27° and 100° C are reported. Apparatus and procedure used are described, methods of calculation outlined, and results obtained discussed with special reference to metals used, and with a view to their application to soaps resulting from the action of acid-containing lub oils at lub surfaces. J. G. H.

866. Temperature dependence of the viscosity of liquids, especially lubricating oils. Introduction of the fundamental viscosity temperature index F.V.T.I. J. Cornelissen and H. I. Waterman. *J. Inst. Petrol.*, 1956, **42** (386), 62–6.—The formula $\log v = \left(\frac{A}{T^x}\right) + B$ is applied to lub and silicone oils. The constants A, x, B are evaluated for several oils, and the expression

$$\log \frac{v20}{v70}$$

is proposed as a fundamental visc temp index (F.V.T.I.). It is suggested that the method should replace other existing

methods for the indication of temp dependence of lub oil visc. 11 literature refs. C. B.

867. Grease consumption standards for new car models are set too high. V. S. Kholyavko and P. D. Atamanenko. *Neft. Khoz.*, 1956, (1), 61–3.—Standard set for grease consumption, *i.e.* 1% by wt of fuel consumption, dates from pre-war days and is shown to be too high for contemporary U.S.S.R. vehicles. Tests made indicate that 0·3–0·4% is a more realistic value, with 0·5% for certain makes of car. V. B.

SPECIAL HYDROCARBON PRODUCTS

868. Determination of magneto-optical rotation of hydrocarbons in the ultra-violet region. Pt 1. Anomalous dispersion in the region of absorption. F. H. Garner, C. W. Nutt, and A. Labbauf. *J. Inst. Petrol.*, 1955, **41** (383), 329.—A micro-polarimeter cell is described and used for the measurement of the magneto-optical rotation of small quantities of liq. Benzene, anthracene, *cyclo*hexanone, 1,2,4-trichlorobenzene, and camphor were investigated. The existence of anomalous magneto-optical rotation is demonstrated by the results. These are consistent with the theory for diamagnetic materials, in the case of the first 4 of the cpds, and camphor gave results consistent with those predicted for paramagnetic substances. 10 literature refs. C. B.

DERIVED CHEMICAL PRODUCTS

869. Alkyltetralins. Pt I. The four ethyltetralins. Pt II. The 2- and 6-methyl-, -*n*-propyl, and -*n*-Butyltetralins. A. S. Bailey and C. M. Staveley. *J. Inst. Petrol.*, 1956, **42** (386), 55–61; **42** (387), 97–103.—The 4 ethyltetralins were synthesized, and their physical properties, including u.v. and i.r. spectra, were measured. 25 literature refs are given.

Pt II shows how the alkyltetralins were synthesized and their physical properties measured. 32 literature refs. C. B.

MISCELLANEOUS PRODUCTS

870. Technology of obtaining and refining resin. W. Huntenburg. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (2), 73–5.—Pt 2. Continuation of the review of production and refining of resin from conifers by solvent extraction. Solvent and dist refining are discussed with relevant patents. Products from various raw materials and their uses, also chem changes during extraction, are discussed. R. T.

CORROSION

871. Cathodic tank protection—5 years later. R. D. Yingling. *Oil Gas J.*, 20.2.56, **54** (26), 113.—A review is given of the use of cathodic tank protection at Gulf Oil Corpn's plant in Kansas area since 1951, and the mechanism of galvanic corrosion and its cost to industry are outlined. G. A. C.

872. Three ways to fight H_2S corrosion. E. B. Backensto, R. D. Drew, and C. C. Stapleford. *Oil Gas J.*, 5.3.56, **54** (44), 104.—Lab, pilot-plant, and commercial unit results show that H_2S corrosion can be reduced by reduction of the gas in process streams, use of chrome–nickel alloys, and aluminium coatings. A table gives chemical analyses of metals used in corrosion tests. G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT

873. Fuel requirements of the small high speed diesel engine. G. M. Barrett and H. G. Freeston. *Gas Oil Pwr*, 1956, **51**, 33–6.—It is necessary that the major part of the combustion should occur near t.d.c.; at 4000 rev/min the process should be complete in *ca* one millisec. The dynamic injection period must not extend over more than 20° crankshaft angle. These high delivery rates are not favourable from the viewpoints of max gas loading and of noise. Pressure charging would reduce noise, reduce the influence of variations in fuels, and increase flexibility, but would add to the cost of the unit.

High speed engine performance would be improved by the provision of a separate combustion chamber and of distributor-type injection pumps.

As regards fuel, ignition quality in excess of BSS 209A requirements does not appear to be necessary for good thermal efficiency and freedom from exhaust smoke at speeds up to 3000 rev/min, but improvement in cold starting is obtained by increasing the Cetane No. A Cetane No. of 50–55 is regarded as desirable. The main effects of boiling range (volatility) are shown in exhaust smoke and exhaust port deposits, but increase in volatility will lower the fl. pt. and may also cause vapour lock. Sp. gr., S content, and pour and cloud points of the fuel are also considered. Summarizing, the ideal fuel for high speed (up to 5000 rev/min) engines should have: high ignition quality, boiling range to give best air utilization and ease of starting, fairly low fl. pt. (85°–100° F), and v.p. low enough to avoid vapour lock. H. C. E.

874. Flame ionization detector. D. P. Duclos and W. M. Grounds. *Rev. Sci. Instrum.*, 1956, **27**, 111.—Describes a fairly simple apparatus for the detection of flames, based upon measurement of the ion concn of flames. It is suitable for use in confined spaces, as for example near the blades of gas turbines, or in the exhaust manifold of I.C. engines. H. C. E.

MISCELLANEOUS

875. Abundant supply potential. Anon. *Petrol. Press Serv.*, 1956, **23**, 82–4.—New estimates of the free world's recoverable proved oil reserves in countries outside the U.S.A., virtually twice as large as many other recent estimates, are contained in a report by W. E. Pratt made for the U.S. Joint Congressional Committee on Atomic Energy. (Published in Vol. 2 of the Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy. The Report has become known as the MacKinney Report after its Chairman, Robert MacKinney.) Coupled with big further additions to recoverable reserves of both oil and natural gas foreseen in the future, ample supplies are predicted to meet rising demands for many decades to come.

(Author's abstract.)

876. How high are octanes going and how will they get there? G. Weber. *Oil Gas J.*, 19.3.56, **54** (46), 186.—The trend in rising octane numbers for motor fuel means that the day of 100 octane premium gasoline may occur in 1957. Although octanes today are higher than are required, competition within the industry will probably keep octanes higher than necessary for most motorists. G. A. C.

877. Who's building and where. Anon. *Oil Gas J.*, 19.3.56, **54** (46), 248.—Construction activity in U.S. and Canadian refineries is listed alphabetically, and shows increases in crude cat reforming, cat cracking, and hydrogen treating capacities during 1956. G. A. C.

878. Refining capacity presses 9 million barrels. L. Turner. *Oil Gas J.*, 19.3.56, **54** (46), 213.—Location, capacity, and type of processing for states in the U.S.A. are listed. The survey of operating refineries shows capacities to nearly 9 million b.d. by 1 Jan. 1956. G. A. C.

879. Oil burners for moderate heat outputs. A. de Chimay. *Times Rev. Ind.*, 1956, **10** (111), 28.—Description (sketch and photo) of Prior Stoker gun-type burner for heat outputs $>10^6$ B.t.u/hr, using 200 sec fuel. Partial mixing of oil and air in rotary blade compressor delivering emulsified oil at 6–9 p.s.i. to combustion chamber through twin nozzles within surrounding blast tube. Advantages claimed are clean flame, easy flame regulation, and avoidance of seepage of unburned oil into combustion chamber when thermostat cuts off fuel. Brief mention is also made of the Shell combustion head, which ensures satisfactory mixing of oil and air, keeps short flame (angle up to 80°) away from ignition electrodes, and minimizes necessity for refractory brickwork. V. B.

880. Application of cost accounting to oil operations. C. J. Taylor. *J. Inst. Petrol.*, 1956, **42** (386), 33–49.—Methods of costing appropriate to the different requirements of upper, middle, and lower management are described. Terminal and continuous costs are analysed, and typical accounts summary sheets are shown. Different forms of cost statement are used for the various operations in the petroleum industry, *e.g.* refining, production, drilling, marketing. 3 literature refs and 4 pages of discussion are included. C. B.

BOOK REVIEWS

Stratigraphic Geology. M. Gignoux. 4th French Edition, 1950, trans. by G. G. Woodford. San Francisco: W. H. Freeman and Co. London: Bailey Bros. and Swinfen Ltd., 1955. Pp. 682 + xvi. $9.50 (80*s.*).

When a textbook has run to four editions it has clearly found a niche in scientific literature. The attainment of this position must not, however, be construed as indicating that "Stratigraphic Geology" is easy to read or abundantly illustrated with general palæogeographical maps. Indeed, the author admits that he has risked such maps on only a few occasions. Diagrams of facies changes are given, and also some maps of the limits of facies, with a note that they are often very hypothetical. Most of the descriptions and stratigraphic syntheses relate where possible to France and the nearby European countries, but there are occasions on which discussions of North America, North Africa, and elsewhere are given.

The text is an admitted mixture of general pictures of the sedimentary history of certain areas, with many stratigraphic details which are not synthesized, as well as descriptions of special facies and famous deposits. This mixing means that the book may be most readable in small sections, rather than by taking all the chapters consecutively. In fact, considerable benefit may be derived by reading the introduction, and the chapters on the Neogene and the Quaternary, before tackling the rest of the book. These chapters include interesting ideas which can contribute to an appreciation of Gignoux' realization of the limitations and imperfections of the syntheses he has attempted.

The translation has been skilfully carried out, and the general presentation is good, but the placing of the notes on various points in the text at the end of each chapter will be considered tiresome by some readers. "Stratigraphic Geology" will be disappointing to anyone expecting a comprehensive series of snapshots of past geographies, but will be valuable to those who look upon it in some senses as a reference book and are prepared to supplement what it has to offer. G. D. H.

Der Geologische Bau der Südamerikanischen Kordillere H. Gerth. Berlin: Geb. Borntraeger, 1955. Pp. 253. DM. 52.50.

The first volume of Gerth's "Geology of South America" was concluded in 1941, but subsequently the entire edition was destroyed during the war. Gerth therefore considered it desirable to present in this second volume a comprehensive description of the geological structure of the South American Cordillera taking into account the essential content of the first volume, supplemented by the results of the latest investigations. With 45 years of study of the geological literature of South America, combined with extensive field work and travels throughout this half-continent, there are few geologists so well qualified as Gerth to write a synthesis of this vast and complex region. The task is made particularly difficult on account of the fragmentary character of our knowledge on the geology of large areas and the very varied nature and scope of the available literature. However, the text of 253 pages, supported by six plates, 62 text figures, and 20 block diagrams represents a highly concentrated amount of information that demands careful study, and in turn offers many new aspects of the stratigraphy and structures of the Andes.

Following an introduction to the position of the South American Cordillera in the framework of the circum-Pacific ranges the first chapter treats the *Antarctandes* embracing: (1) the Patagonian Cordillera; (2) the Cordillera of Tierra del Fuego and its extension to the Antarctic; (3) the Patagonides; and (4) the Nahuel Huapi area. The second chapter deals with the *Southern Central Andes* and the accompanying mountain ranges sub-divided into the Argentine–Chilean Cordillera of four structural units, and the related ranges lying to the east consisting of another four units. The third chapter discusses the *Northern Central Andes* (*Peruandes*) under the headings of: (1) Coastal Cordillera of Peru; (2) Western Cordillera of Peru; (3) Central mountain-mass and "Cordillera Blanca"; (4) Eastern Cordillera of North Bolivia and Peru; (5) Sub-Andean belt of North Bolivia and Peru. The fourth, and from an oil geologist's point of view most interesting chapter, treats the *Caribandes*, composed of the following major units: (1) the Coastal belt of Ecuador and the Coastal Range of North Colombia; (2) the Western Cordillera of Ecuador and Colombia and their virgation; (3) the "Cordillera Real" of Ecuador and the Central Cordillera of Colombia; (4) the Eastern Cordillera of Colombia and its precursors in Ecuador; (5) the Sub-Andean belt in the foreland of the Eastern Cordillera of Ecuador and Colombia; (6) the virgation of the Eastern Cordillera of Colombia; (7) the Caribbean mountain range of Venezuela. The fifth chapter deals with the distribution of the young volcanoes of the Cordillera and their relation to the structures of the mountains and large troughs. The final chapter is a comprehensive review of: (1) the Andean sedimentary environment; (2) the orogenic movements with their resulting structures; (3) the magmatic phenomena.

The oil geologist will find a great deal of food for thought

in the discussion of the Neuquenides, with their Jurassic oil deposits, or the structural conditions surrounding the Pirin oilfield of Lake Titicaca and the prospects of Devonian oil in the Sub-Andean belt of Northern Bolivia and Peru. The structural setting of the Ganso Azul field at the Ukayali river is discussed with the Sub-Andean petroliferous belt to the north of it. The Pacific coast oilfields of Peru and Ecuador are mentioned in their regional geologic position and so are those of the Magdalena valley, of West and East Venezuela, and of Trinidad.

The structural geologist will read with interest the masterly synopsis of the geology of ranges such as that of Merida. The relationship of exposures of basement rocks in the Caribbean Coast Range with rocks of the Guayana shield or with those of the residual islands of the old landmass "Caribia," assumed to have existed north of the Venezuelan coast, forms a fascinating topic.

The intensive folding in the Caribbean and Antarctic geosynclines are compared with the relatively gentle folds of the main Andean Cordillera, seemingly controlled by a block-faulted basement.

The petrologist will find constructive suggestions in comparative descriptions and age correlations of the Andean plutons and their magmatic differentiations.

The reading of the text would have been facilitated by referring to a closer grid of latitudes and longitudes as shown on the block diagrams, especially as only a limited number of the geographic names mentioned in the text could be inserted. There are some errors in spelling of names and a few wrong references to figures, otherwise text and graphs are well printed and bound. H. G. K.

Theory of Combustion Instability in Liquid Propellant Rocket Motors. L. Crocco and Sin-I Cheng. London: Butterworths Scientific Publications for Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization, 1956. Pp. viii + 200. 37*s*. 6*d*.

This book attempts a theoretical mathematical analysis of two types of combustion instability in liquid propellant rocket combustion chambers.

To the practical rocket research worker most of the mathematics will be interesting if he has the turn of mind to admire mathematics for its own sake. If he is faced with an actual chugging or screaming problem in one of his own motors, he is more likely to solve the differential equations by physical methods than by substitution in the equations of this book.

These rocket instabilities are fortunately rare in established rocket systems and are usually associated with experimental work on new propellants. No mathematics can solve incompatible chemical reactions, and violent instability is usually the result of such rather than the physical parameters postulated by the authors. Another vital factor is the design of injector or mixing nozzle which again is much more amenable to trial solutions of a physical nature than to mathematical analysis.

The book would be vastly improved if even only one or two examples of direct calculation had been given in association with some experimental work. While the latter is quoted it is unfortunately still in a form where the original reference would have to be obtained to make a coherent story. I. L.

ADDITIONS TO THE LIBRARY

British Standards:

B.S. 1136: 1956. Mild Steel Refuse Storage Containers. Pp. 8. 2*s*. net, post free.

B.S. 2733: 1956. Intrinsically Safe Magneto-Call Telephones Primarily for Use in Coal Mines. Pp. 6. 2*s*. net, post free.

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Zeiler, C. A., 935

OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

881. Natural gas production 100 miles from New York City? H. T. Brundage. *World Oil*, 1956, **142** (2), 40.—Gas has been found in Devonian shale near Phœnicia in the Catskill Mts area *ca* 100 miles NNW. of New York. Pay is at 5360 ft and production is *ca* 100,000 cu. ft/day. Structure and stratigraphy in the area are very complex, and much geological and geophysical work has been carried out in the area immediately W. of the Catskill Mts.

Several wells have recently been drilled in the general area; some of these were abandoned at 6438 ft in ? Cambrian.

C. A. F.

882. Wilshire Ellenburger field, Upton County, Texas. M. A. Colligan and J. Q. Tomkins. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (12), 2484–504.—The Wilshire Ellenburger field is in W.-central Upton County, Texas. The field, in the Midland basin part of the Permian basin, was discovered in April 1951, with the completion of the Sinclair Oil and Gas Co's McElroy No. 1 in the Ellenburger at total depth of 12,438 ft.

The proved Ellenburger producing area is 1600 acres and is 2½ miles in length and 1½ miles in width, with a productive anticlinal closure of 577 ft. On 1 Jan. 1955, 12,278,824 brl of 54° API gravity oil had been produced from the Ellenburger.

E. N. T.

883. Macro-invertebrate assemblages as indicators of sedimentary environments in East Mississippi delta region. R. H. Parker. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (2), 295–376.—This paper describes one of a series of studies of near-shore sedimentary environments in the N. Gulf of Mexico, supported by the API as Project 51, at Scripps Institution of Oceanography under the direction of F. P. Shepard. The study was made on the E. side of the Mississippi delta in Breton Sound and beyond in the open Gulf of Mexico from the shore to approx the 90-fathom contour.

Comparison of the distribution of the hydrographic factors with the physiography of the land-masses in this area with the macro-organism distributions made it possible to formulate criteria for the interpretation of ancient environments as far back as the Miocene on the Gulf and Atlantic coasts.

E. N. T.

884. Hugoton embayment commands fresh look. D. F. Merriam. *Oil Gas J.*, 5.3.56, **54** (44), 82.—The geology of the Hugoton embayment in Kansas is described; it is a large synclinal shelf area of the Anadarko basin bordered on 3 sides by uplifts. The structural history is shown by isopach maps of each of the following intervals; (1) pre-Cambrian–Arbuckle; (2) Arbuckle–Viola; (3) Viola–Mississippian; (4) Mississippian–Lansing; and (5) Lansing–Stone Corral. Each of these maps is described, and it is shown that there is a record of transgression and regression with intervening periods of erosion.

Several formations are productive in the area, and the Arbuckle has recently been found oil-bearing in Scott County.

This important discovery justifies a new evaluation of potential pays in the embayment where the Late Palæozoic has been little explored. C. A. F.

885. What the Hugoton activity means. G. F. Thomas. *World Oil*, 1956, **142** (2), 75.—Exploration and oil prospects of the Hugoton embayment in SW. Kansas are described. The area has relatively little structural relief, and much of the drilling has been concentrated in the central part, where there are conditions for stratigraphic trapping within the Pennsylvanian Morrow and the Mississippian Chester. These are 2 of the more important producing formations, the Morrow producing from sand lenses and the Chester from truncated limestones. An intensive study of the sedimentation of the area and the structural history is suggested as the most promising exploration technique. Maps and cross-sections of the area are included. C. A. F.

886. Faulting, accumulation, and fluid distribution in Ramsey pool, Payne County, Oklahoma. S. S. Umpleby. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 122–39.—The study of faulting is playing an increasing role in the search for oil. The Ramsey oil pool, in N.-central Oklahoma, offers evidence on the effect of faulting on the migration of oil, both horizontal and vertical. It also affords evidence on the time of migration relative to the stages of structural growth.

The study shows that: (1) oil accumulated during a long period of structural growth; (2) vertical migration occurred along the fault and continued to the present; (3) migration across the fault reached different degrees of perfection in different reservoirs; and (4) fault movements occurred in 3 stages, the first being dominantly horizontal and the others vertical. E. N. T.

887. Mississippian production in the Osage. J. A. Hayes. *World Oil*, 1956, **142** (2), 85.—The geological history of Osage County, Oklahoma, and the development of production from the Mississippian are described. Beds range from Cambrian to Permian, with an important unconformity between the Pennsylvanian and Mississippian involving folding and faulting and the weathering of Mississippian limestones. Oil and gas have been produced from the Mississippian in the area for many years, and several of the older fields are briefly described. In recent years there has been development of the Mississippian Chat as an important pay in which permeability appears to be dependent on the degree of weathering. The area of most recent interest has been the Whitetail field, where oil has been found in the Chat and in the underlying Cowley cherty limestone; the limestone pays are fractured zones. 5 refs. C. A. F.

888. Permo-Pennsylvanian formations between Laramie Mountains, Wyoming, and Black Hills, South Dakota. R. L. Bates. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (10), 1979–2002.—The subject of this paper is a variable sequence of clastics, carbonates, and evaporites, which are exposed in the NE. Laramie Mountains and the Hartville uplift of Wyoming and the Black Hills of S. Dakota, and which are penetrated by wells in intervening areas. The ages of these rocks range from Late Mississippian or Early Pennsylvanian to Early Permian, and their thicknesses range from 535 to 1335 ft. 4 formations are recognized: Casper, Hartville, Fairbank, and Minnelusa. E. N. T.

889. Lyre formation (redefinition), Northern Olympic peninsula, Washington. R. D. Brown, Jr., P. D. Snavely, Jr., and H. D. Gower. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (1), 94–107.—Detailed geologic mapping in the N. Olympic peninsula, Washington, has shown that conglomerate, sandstone, and siltstone strata, previously referred to the Lyre formation, are divisible into 2 mappable units. The Lyre formation, therefore, is redefined to include only a sequence of sandstone and conglomerate that comprised the lower part of the formation as previously described. These strata average *ca* 1300 ft in thickness, but locally they may be as thick as 3300 ft. Heretofore these rocks were thought to be Oligocene in age; however, recent field work indicates that they are early late Eocene in age and are overlain with erosional unconformity by strata containing foraminifera of late Eocene age. E. N. T.

890. Geology of Northwestern Alberta and adjacent areas. J. Law. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (10), 1927–78.—The area described lies in Alberta, N. of Township 90, between the Fifth Meridian and the British Columbia border and that part of the NW. Territories between the N. boundary of Alberta and Great Slave Lake. This area forms part of the Interior Plains of Canada which extend westward as far as the N. Rocky Mountains and foothills of NE. British Columbia and the Nahanni Range of the NW. Territories.

Sediments present in the area are mainly of middle and late Palæozoic and Mesozoic age. The oldest rocks are marine redbeds of middle or early Palæozoic age. The Devonian, Mississippian, Permo-Pennsylvanian, Triassic, and Cretaceous rocks consist of marine sediments of shelf and intracratonic basin types; carbonates and evaporites predominate in the lower part, terrigenous clastics in the upper part. Jurassic and Tertiary rocks are absent. The Pleistocene deposits are glacial in origin.

Towards the S., the thickness of Middle Devonian sediments was controlled by a granitic land area herein referred to as the Peace River land-mass. The max stratigraphic thickness in NW. Alberta is *ca* 10,000 ft.

Facies studies were used to forecast areas of favourable reservoir rock. Oil and gas showings occur in the N. part of the area where there are chances of commercial production. E. N. T.

891. Mississippian stratigraphy of the Daly oilfield. D. W. Organ and G. M. Russin. *Canad. Min. metall. Bull.*, 1956, **49** (527), 193–8.—The paper reviews the stratigraphy of Mississippian rocks within the Daly field and outlines a system of nomenclature which has become established in this field only. 6 figs. M. P. T.

892. Orléansville earthquake and turbidity currents. B. C. Heezen and M. Ewing. *Bull. Amer. Ass. Petrol. Geol.*, 1955, **39** (12), 2505–14.—An earthquake of magnitude 6·7 violently shook the area near Orléansville, Algeria, on 9 Sept. 1954. The area of appreciable damage extended 15 miles from the epicentre, and following the earthquake 5 submarine cables lying on the floor of the Mediterranean Sea broke at distances of 40–70 miles NW. of the epicentre. Since the cables were broken at a considerable distance from the area in which appreciable damage was inflicted by seismic energy, it is believed that the cables were broken by a mass of sediment shaken loose by the earthquake but moved down the slope and far out into the abyssal plain by its own potential energy. This interpretation is similar to that advanced for the cable breakage S. of the epicentre of the 1929 Grand Banks earthquake. E. N. T.

893. Stanvac exploring 20,000 square miles in Pakistan. H. T. Brundage. *World Oil*, 1956, **142** (1), 179.—Exploration is being carried out in E. Pakistan in the Bengal basin and in W. Pakistan near the mouth of the Indus River. Magnetometer work has been completed in the Bengal area and a gravity survey is being made to precede a seismic survey. Surface geological work has been carried out. In W. Pakistan, where the concession is *ca* 200 miles S. of the Sui gas field, an airborne magnetometer survey was completed last year, followed by gravity, seismic, and surface geological mapping. The W. Pakistan basin contains 20,000–30,000 ft of mainly Tertiary sediments. C. A. F.

894. Russia claims two new discoveries drilled. Anon. *World Oil*, 1956, **142** (2), 178.—2 discoveries are reported from the "Second Baku" area of Russia between the Volga River and the Ural Mts. The N. of the 2 is in the Yarinsk area near the junction of the Kama and Chusovaya rivers and the S. is in the Sheshma Valley, where a number of wells is being drilled. C. A. F.

DRILLING

895. Evolution of low solids drilling fluids. N. O. Campise. *World Oil*, 1956, **142** (2), 102.—Physical properties of muds are briefly reviewed and 2 requirements are emphasized: (1) minimum clay hydration; (2) a low concn of drilled solids in the fluid. The first requirement is solved by using lime-based muds, and the second by mechanical separation by the centrifuge. It has been shown that in this form of separation the visc and gel strength can be held at a lower value than by dilution.

The method currently used removes excessive clay and also returns 95–98% of the barite to the mud systems. 14 refs.
C. A. F.

896. Hydraulic drill collars increase drilling efficiency. A. Seligman. *World Oil*, 1956, **142** (1), 101.—The use of hydraulic drill collars in drilling is discussed in detail. The collar consists essentially of a fixed cyl attached to the bottom drill collar and a telescoping tube which operates as a piston within the cyl. There are rollers and grooves in each part which act as a spline combination permitting rotation of the bit.

Equipment has been tested in several areas, and some of the results which are described are of great importance. It has been shown that drill string and rig vibrations have been dampened and penetration rates locally increased. 4 refs.
C. A. F.

897. New aluminous cement developed for oil wells. J. S. Talbot and A. Gibbon. *World Oil*, 1956, **142** (1), 99.—A new aluminous cement is now available to the industry; it is a mixture of inhibited phosphoric acid and 2 solids which form an easily handled slurry which can be used over a temp range of 130°–200° F. An accelerator is used to control working and setting times for various temp.

The principal advantages of the material are listed, and these include no shrinkage, high bonding strength, resistance to shattering, and controlled setting time. It can be used in any job where conventional material is now used.

Tables give data on the properties of the cement and field results.
C. A. F.

898. When does it pay to drill with air? J. T. Morris and R. P. Ramsey. *World Oil*, 1956, **142** (1), 112.—The economics of air drilling are discussed, and 3 examples are given. 5 rules-of-thumb are provided: (1) the added cost of the compressor system is negligible in relation to total well costs; (2) air drilling can reduce circulation costs; (3) greater penetration rate in certain rocks; (4) expense of an extra string of casing; and (5) an effective process to shut off water zones in air-drilled wells requires development.
C. A. F.

899. Jet bit drilling equipment. . . . What's the economic limit? R. M. Bordon. *World Oil*, 1956, **142** (2), 106.—The economics of drilling with jet bits are discussed. These bits have a much higher penetration rate and up to 30% longer life than conventional bits, and they have been used at an increasing rate during the last 2 years. Problems have arisen: pumps adequate for normal drilling have been overloaded, with consequent increased maintenance costs and the need for larger and more costly pumps. Efficient use of pumping systems in jet bit drilling is discussed, and although h.p. may be increased by multiple pump operation, this has not been effectively carried out in Canada, where larger pumps and accessories are used.
C. A. F.

900. First Pacific coast permanent drilling island modified to allow drilling of 70 wells. E. E. Pyles. *J. Petrol. Tech.*, 1955, **7** (12), 13–16.—The island is 1½ miles off Seal Beach, in 45 ft of water. Its dia is 75 ft, with a wharf 74 ft and 51 ft on the shoreward side. The outer rim is interlocking steel sheet piling driven 15–20 ft into the sea bed. The interior is filled with sand and rock. Concrete beams on wood piles support a reinforced concrete floor. Its construction followed a successful well drilled on shore, with 9271 ft seaward deviation, involving deviation of up to 70° in a drilled distance of 12,187 ft. Its outer walls are protected by 14,600 tons of rip-rap. An 8-ft wall protects workers, except on the wharf side. Reinforced mud tanks are set under the elevated rig substructure, and mud pumps are under the drilling engines. Tanks store fresh water and fuel oil; ready-mixed mud is brought by barges; and cementing and logging equipment is on barges. Crews move in each shift, but provision is made for emergency stops up to 2 days. Safety equipment of various kinds is available.

6 wells were drilled with no shore pipeline connexions. An 8-inch and 3 3-inch somastic-coated steel pipelines, with a telephone cable, were laid from land to the island, the 8-inch line being for production, one 3-inch line for testing, and the others for mud, fuel oil, or fresh water.

The 3 originally planned wells were successful, and modifications have allowed 6 more to be drilled. The floor is being raised to enable 60 further wells to be drilled, the conductors having been driven *ca* 5 ft apart, and the sand in a 4-ft wide band inside the shell having been replaced by gravel which has been grouted.
G. D. H.

901. Drilling in the Delaware basin shows new depths reached with natural gas. W. W. Dallas and E. J. Coel. *World Oil*, 1956, **142** (1), 109.—The drilling procedure for Poker Lake Unit No. 2 in the Delaware basin is described in detail. Gas was used as a circulating medium, and a 8¾-inch hole was gas drilled to 13,792 ft, believed to be a depth record for a gas-drilled well. It is claimed that gas drilling of this well has proved that an appreciable saving can be made over the normal cost of wildcatting. A drilling log of the well is included.
C. A. F.

902. Oklahoma producing depth record set. Anon. *Oil Gas J.*, 20.2.56, **54** (42), 86.—The drilling history of 2 Harrison in Knox field, Grady County, Oklahoma, is briefly described. It is the deepest producer in the state and has been completed for oil and gas production at *ca* 15,300 ft in Ordovician Bromide sands some 300 ft thick. Rates were 30–40 brl dist/hr and 5,500,000 cu. ft/day gas. Thrust faulting was found below 10,000 ft involving Pennsylvanian and Mississippian beds.
C. A. F.

PRODUCTION

903. Conduction of heat incident to the flow of vaporizing fluids in porous media. F. G. Miller and K. A. Seban. *J. Petrol. Tech.*, 1955, **7** (12), 45–7.—In the flow of vaporizing propane through a horizontal column of sand correspondence has been shown between the observed pressure distribution and that predicted on the assumption that the enthalpy of the propane did not vary along the column. The assumption was based on principle of conservation of energy. In the present study 3 flow régimes are considered: entrance region where liq approaches saturation state, transition region with gas and liq (only liq flowing), exit region, where gas flow occurs and vaporization of liq begins. Energy balance principles are applied mathematically to these regions, and it is concluded that in the experiment the heat conduction effective was not of any consequence. On applying the equations derived to this experiment it was concluded that there was a negligible pressure drop in the entrance region and that the transition region was probably only a few pore dia long.
G. D. H.

904. Investigation of various refined oils for formation fracturing. A. R. Hendrickson, G. L. Foster, and R. B. Rosene. *J. Petrol. Tech.*, 1955, **7** (12), 39–42.—In fracture treatments the use of refined oils has greatly increased, and several typical oils have been examined. The oil base ranged 47–95%, wax trace to 33%, and total asphalt (residue at 360° C 10 mm pressure) 5–33%. Most base oils were of low visc, but one was high. Asphaltic material reduces sand-falling velocities, but possible pptn by dilution with some crude oils could plug fractures. Waxes also reduce sand-falling rates, and in low temp wells might plug flow channels, or deposit elsewhere.

Low fluid loss is important in fracturing, and may be ob-

tained by adding plugging material or by raising the visc of the oil. Asphaltic micelles and waxes may act by plugging in an undesirable manner. An oil with comparative absence of wax and asphalt, with other properties satisfactory, should give the best results, and would also be compatible with the crude oil in the formation. G. D. H.

905. Some useful tables for approximating smooth curves by fifth- and lower-degree polynomials. H. H. Rachford and W. P. Schultz. *J. Petrol. Tech.*, 1955, **7** (12), 43–4.—The solution of physical problems by computing machines requires the data to be presented in a form the machine can use. A method which has been found useful for this purpose is based on finding an easy-to-evaluate function $F(x)$, with only a few coeff, which is a good approximation to $\phi(x)$, a smooth curve representing the data, in the interval $0 \leq x \leq x_n$. The mathematical means of solving this problem is given, together with the associated tables, and the method of using the tables is described. G. D. H.

906. Wettability versus displacement is water flooding in unconsolidated sand columns. J. Newcombe, J. McGhee, and J. Rzasa. *J. Petrol. Tech.*, 1955, **7** (12), AIMME Tech Paper No. 4179, 227–32.—Sands and a silica plate were simultaneously treated with known weights of sil :one dissolved in *iso*propyl alcohol, the alcohol being evaporated. The silica plate was used for contact angle measurements, and the sands for filling columns from which oils of different visc and interfacial tensions were displaced by water flooding at known rates. Surfaces of varying degrees of wettability were prepared. It was found that for both oil-wet and water-wet systems and low visc oil the recoveries were dependent on interfacial tension, and increased flood rates gave higher oil recoveries. In water-wet systems high interfacial tensions gave better oil recoveries than low interfacial tensions, while low interfacial tensions gave better recoveries in oil-wet systems. Intermediate or neutral wettability systems were less sensitive to flood rate and interfacial tension than the other 2 systems.

The influence of surface forces on the recovery of high visc oils was less well defined than for low visc oils. High visc oil systems had better oil recoveries at low than at high rates.

The possible mechanisms are discussed, and it is noted that the contact angles and interfacial tensions used are static values measured outside the flowing system. G. D. H.

OILFIELD DEVELOPMENT

907. Paradox basin begins its pay off. F. J. Gardner. *Oil Gas J.*, 27.2.56, **54** (43), 179.—Over 4000 wells were drilled in the Rocky Mountain area in the U.S.A. in 1955, and discoveries added substantial reserves to the district's potential. There have been discoveries in the Paradox basin in SE. Utah and SW. Colorado, where a recent wildcat, 1 Navajo C, San Juan County, Utah, flowed oil from basal Hermosa at *ca* 5800 ft.

The basin is characterized by rapid lateral changes in facies; structures found are small, but there are strong shows, and 2 flush fields have recently been discovered. C. A. F.

908. Deep drilling pays off in Oxhard field. W. T. Smith. *Oil Gas J.*, 13.2.56, **54** (41), 172.—Development of deep production in the Oxhard field, Ventura County, California, is outlined. The field was found in 1936, and production was developed at 2300–3800 ft in the Modelo shale, which is fractured; oil gravity is 8°–10°, and wells are heated to produce the oil. Since 1952 there has been development of Sespe sand production which lies beneath Topango Volcanics (750–2500 ft thick) separating the Modelo and the Sespe. 3 zones have been found with 20 wells producing *ca* 1700 b.d. The accumulations are associated with a buried faulted dome modified by stratigraphical variations. Deepest production is at *ca* 10,000 ft. C. A. F.

909. Parentis is fast developing into major European field. Anon. *World Oil*, 1956, **142** (2), 172.—The Parentis field in SW. France was discovered in 1954, and an area over 6 miles by *ca* 2 miles has been proved productive to date. It is producing approx 5 million brl/year, and production is expected soon to exceed that of Schoonebeek, currently the largest field in Europe.

The field was located after gravity and seismic surveys, and pay is Cretaceous dolomitic limestone at *ca* 7500 ft. Well potential is apparently related to dolomitization, although there is a broad anticlinal structure. Another field 7 miles ENE. of Parentis was discovered at Mothes in 1955 with pay equivalent to that at Parentis. Seismic work is currently being carried out, and a number of wildcats is being drilled. C. A. F.

TRANSPORT AND STORAGE

910. New methods for the measurement of oil quantities. O. Falk. *J. Inst. Petrol.*, Jan. 1956, **42** (385), 27.—Description of various instruments designed to measure levels of liq surfaces. Aspects covered are: the vol measurement of tanks, measurement of losses, measurement of oil by weight, tank calibration, measurement of water and oil flow, automatic calculation of quantity flowing. C. B.

911. Evaporation losses from petroleum storage tanks in the United Kingdom—a practical survey. E. H. Walker, R. M. Eltringham, and A. Puttick. *J. Inst. Petrol.*, Oct. 1955, **41** (382), 297–325.—The paper describes a method for the correlation of thermal breathing loss measurements, which were obtained from standing and working tanks throughout the U.K. The importance of maintaining the tank and its fittings in vapour-tight condition is emphasized. The mathematical basis of the survey and the applications of the derived formulæ are given. 6 literature refs and 6 pages of discussion are given. C. B.

912. Hydraulics for pipeliners. Pt XVIII. C. B. Lester. *Pipe Line News*, 1956, **28** (2), 19–25.—It is important to provide sufficient suction head for centrifugal pumps to prevent cavitation and possible damage to pumping equipment. When multiple pump installations are used, operating characteristics depend on the method of link up. B. A. F.

913. Locating casing shoe leaks with radio-active argon. J. Kohl, R. L. Newacheck, and E. E. Anderson. *J. Petrol. Tech.*, 1955, **7** (12), AIMME Tech Paper No. 4182, 213–16.—A few weeks after gas injection had been begun for storage in the Herscher dome, Illinois, gas leakage was detected at the surface. Old wells only went down a few hundred feet, and not near to the storage horizon. Gas was evidently in a watered horizon over the storage zone. The possibility of leakage via the cement annulus around the injection wells was considered. A technique using radio-active argon was employed. This was released at the bottom of the well, with a γ-ray detector a short distance above the container. Gas flow into the well was adjusted to prevent the radio-active gas from flowing upwards in the well bore. Very small leaks in the casing or out of the well-head could be measured by timing the up-hole movement of the radio-active gas.

At the end of each test a γ-ray log of the well was made, and compared with the original γ-ray log to search for new radiation abnormalities. In other tests the argon was mixed with varying lengths of casing gas to ensure that the argon could reach any casing leak.

The tests revealed no gas leakage up through the casing annulus in the vicinity of the casing shoe. G. D. H.

914. Modern crude oil loading techniques at Mina-al-Ahmadi, Kuwait. J. M. Dougary. *J. Inst. Petrol.*, Jan. 1956, **42** (385), 1.—The article describes the facilities for crude oil handling at the Kuwait Oil Co's Mina-al-Ahmadi terminal. The expansion in the terminal's capacity is described. (*cf.* Abs. **554**, 1956). C. B.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

915. Electronic control for new Unifiner. D. P. Thornton. *Oil Gas J.*, 9.4.56, **54** (49), 110.—The first automatically-controlled Unifining unit, which has now been in operation more than 2 months at Rock Island Refining Corpn refinery near Indianapolis produces specially treated feed stock for the UOP Platforming unit. Electronic instrumentation, installation, and controller operation are described. G. A. C.

916. Manufacturers will co-operate. M. L. Murdock. *Oil Gas J.*, 12.3.56, **54** (45), 107.—Major objectives in the programme for developing an improved set of standards for centrifugal pumps include standards acceptable to users, interchangeability of liq ends between frame-mounted and close-coupled units, and quantity production of liq end. G. A. C.

917. Centrifugal pump standardization. D. C. Brand. *Oil Gas J.*, 12.3.56, **54** (45), 106.—Lack of standardization on centrifugal pumps is costing the industry millions of dollars each year; and it is estimated that standardization in the chemical industry alone would save $6,800,000 annually. The external dimensions of pumps should be standardized to effect interchangeability. G. A. C.

918. More compressor horsepower, reduced noise level. R. C. Baird. *Oil Gas J.*, 9.4.56, **54** (49), 98.—Latest techniques are described in reducing noise level at the increased capacity Plaza Del Rey compressor station belonging to the Southern California Gas Co. At the same compressor horsepower was increased—the primary noise sources can be reduced by careful design of manifolds and flow passages, of exhaust and intake lines, and their manner of acoustical termination. G. A. C.

919. Operation of petroleum processing tube equipment under winter conditions. K. V. Kostrin. *Neft. Khoz.*, 1956, (2), 47–53.—Discussion of measures required to ensure satisfactory shut-downs, so as to avoid start-up troubles, when temp down to −45° C may be expected. Description of line-draining methods and of special connexions therefor and for flushing with light fractions. V. B.

920. Continuous automatic sampling. 1. P. L. de Verter and W. E. Scovill. *Oil Gas J.*, 2.4.56, **54** (48), 124.—This is the first of a 4-part series, and reviews the history and theoretical aspects of continuous sampling. Accurate sampling is a necessity, and the article stresses the need for fundamental work to be done on the theory of continuous sampling, and discusses patterns of heterogeneous flow, direction of flow, and in-line blending on sampling techniques. G. A. C.

921. An investigation into the air-heater corrosion of oil fired boilers. B. Lees. *J. Inst. Fuel*, Apr. 1956, **32** (183), 171.—Methods which have been successfully applied at Bankside to reduce air-heater fouling and corrosion are described. Experiments to be made to determine the optimum operation conditions and the most suitable air-heater design are discussed. A description of an apparatus for determining the concn of solid combustible matter in the flue gases is appended. 3 literature refs. D. K.

922. Octane-boiling point correlation for virgin naphthas. W. A. Lewis and J. H. Ottenweller. *Oil Gas J.*, 2.4.56, **54** (48), 132.—A chart is provided by which the octane rating of the highest boiling straight-run gasoline in the pool can be determined in order to estimate optimum cut point. G. A. C.

923. Skelly installs waste-treatment facilities at El Dorado. Anon. *Oil Gas J.*, 12.3.56, **54** (45), 104.—The plant, built in Kansas to API standards, can handle 15,000 gal of oil waste/minute, and has an impounding basin of 16,500,000 gal. G. A. C.

924. Steam and power in the gas and coking industry. L. Y. Clark. *J. Inst. Fuel*, March 1956, **29** (182), 106.—An outline is given, based on N. Thames Gas Board experience, of the recent trends in steam and power demand of gasworks and methods of effecting fuel economies. In one section of the paper oil gasification processes are discussed and flow sheets are included. The article is well illustrated and there are 13 literature refs. D. K.

CRACKING

925. Making ethylene. 2. Processing scheme—pyrolysis methods. H. C. Schutt and S. B. Zdonik. *Oil Gas J.*, 2.4.56, **54** (48), 99.—This part reviews ethylene processing methods in general, and compares the pyrolysis methods as follows—cracking coil, cracking coil with steam heat carrier, and regenerative, both stationary and moving. 11 tables. G. A. C.

926. Nothing stands still at Suntide. L. Resen. *Oil Gas J.*, 20.2.56, **54** (42), 115.—Operations at the Corpus Christi plant are reviewed after 2 years' work; crude capacity has been considerably increased and cat cracker operations improved, with trouble-free runs on the alkylation unit. G. A. C.

927. Natural catalysts for cracking petroleum products. J. Sirola and I. Orsic. *Nafta (Yugoslavia)*, 1956, **7** (1), 10–17.—Cat properties of some Yugoslav bentonites have been examined in the raw state, as well as after chem treatment. The bentonites from 2 of the 8 examined and economically interesting places have shown satisfactory CAT/A activity. These are bentonite D from Ljesljani in Bosnia and Herzegovina and bentonite B from Studena Bara in Macedonia. The selectivity of the cat prepared from clay B is weaker because of the high content of iron, and therefore tests have been made for removing the surplus iron by the "wet" method. However, this way it was not possible to remove enough iron from the structure of montmorillonite. In the clay D maximal activity has been achieved when 5·2% of R_2O_3 has been removed from the dry clay by acid treatment. In the clay A (Petrovac n/m), which contains a certain amount of free SiO_2, a higher activity has been achieved after a complex alkalic and acid treatment. Parallel technological tests have been made with foreign natural and synthetic cat. It has been established that: (1) the structure and composition of domestic cat are of the same kind as those of foreign natural cat; (2) the initial activity and selectivity of cat are nearly equal to those of the synthetic cat, while the normal ageing accords better with that of the natural cat. (Authors' abstract.)

CHEMICAL AND PHYSICAL REFINING

928. Obtaining lighting kerosine from distillates of high-sulphur crudes by hydrofining without introduction of external hydrogen. M. V. Lobeev, A. D. Sulimov, and A. V. Agafonov. *Neft. Khoz.*, 1956, (1), 59–61.—150°–300° C cut can be 97–99% desulphurized over Al–Co–Mo cat (660 hr life) provided partial H_2 pressure $\not<$ 9 atm, which requires 370°–400° C and 20 atm operating conditions. Yield 95+ %, product requires stripping to remove low-flash C_3—135° C fract formed by slight cracking. V. B.

SPECIAL PROCESSES

929. Mercury addition compounds of olefins and their possible introduction for olefin separation. G. Spengler *et al.* *Brennst-Chemie*, 1956, **37** (3–4), 47–53.—Addn of olefins to mercuric acetate is discussed. The reaction takes place with all solvents which have an active H atom in the mol. The addn cpds are decomposed with HCl and the raw materials re-

generated. In the change with mercuric acetate in methanol the reaction velocities with 1-, 2-, and 3-olefins are *ca* 100 : 10 : 1, whereby between 3-olefins and those with the double bond further in the mol important difference no longer exists. Likewise an *iso*-branching exerts an influence depending on its position relative to the double bond. Olefins may be separated from gas mixtures, *e.g.* waste and cracked gases. A scheme is presented for continuous separation of C_3H_8 and C_3H_6. R. T.

930. Special study of sulphur removal and recovery from fuels. Organizing Committee of the Study to the Council of the Institute of Fuel. *J. Inst. Fuel*, March 1956, **29** (182), 138.—Aspects considered are: deleterious effects of sulphur in fuel—in pig iron production, steel production, glass manufacture, steam raising, I.C. engines, domestic heating and air pollution; sulphur removal and recovery from fuels, *i.e.* coal, town gas, coke-oven gas, combustion gases, fuel oil; and utilization of recovered sulphur. D. K.

PRODUCTS

CHEMISTRY AND PHYSICS

931. Applied chemical kinetics. XIII. Photochemistry. J. C. Jungers and F. Eschard. *Rev. Inst. franç. Pétrole*, 1956, **11**, 66–108.—(*Cf.* Abs. **1446**, 1955.)

932. Studies on the oxidation and auto-ignition of paraffinic hydrocarbons in the gas phase. Mixtures *n*-hexane–air. E. Fréling. *Rev. Inst. franç. Pétrole*, 1955, **10**, 1224–79, 1543–610; 1956, **11**, 134–57. Introduction (general aspects of oxidn and spontaneous ignition of gas mixtures); methods and apparatus (measurement of ignition temp, kinetic study of oxidn, preparation of *n*-hexane); study of ignition temp (ignition diagrams of hexane–air mixtures, influence of size and ageing of reaction vessels on ignition temp of hexane–air mixtures, study of the secondary reaction due to CO, ignition vol (pressure, temp, concn), study of critical delays, classification of fuels); study of ignition delays and oxidn kinetics of hexane–air mixtures (delays in cold flames, cold flames within the range, reaction rates in the cold flame zone, slow oxidn of normal flames, delays in normal flames); oxidn mechanism of hydrocarbons (low temp, high temp); conclusions. 253 refs. V. B.

ANALYSIS AND TESTING

933. Simultaneous determination of traces of benzene and toluene. W. Hancock and E. Q. Laws. *Analyst*, 1956, **81**, 37–41.—Under specified conditions nitration of traces of C_6H_6 and toluene yields *m*-dinitrobenzene and 2 : 4 : 6-trinitrotoluene. These are extracted and determined by the colour reaction with KOH and butanone (other ketones may be used), the optical *d* at 4620 and 5650 Å being measured within 5 minutes after mechanical shaking for 15 minutes. Factors for pure C_6H_6 and toluene are determined under exactly the same conditions and must be re-determined for each fresh batch of ketone. Range covered is 0–50 μg of both nitration products. W. A. M.

934. Detection and determination of traces of polynuclear hydrocarbons in industrial effluents and sewage. IV. Quantitative examination of effluents. P. Wedgwood and R. L. Cooper. *Analyst*, 1956, **81**, 42–4.—Method described previously (*cf.* Abs. **71**, 1956) is made quant by measuring peak ht at fixed slit width. Detailed methods are given for sewage works and carburetted water gas effluents and spent ammoniacal liquor. Pyrene cont down to 0·1 p.p. 10^9 can be determined. Other hydrocarbons determined include acenaphthylene, alkylpyrene, fluoranthene, and 3 : 4-benzpyrene. W. A. M.

935. Shear stability of lubricating greases. C. A. Zeiler. *NLGI Spokesm.*, Jan. 1956, **19** (10), 16–19.—Results of tests of shear stress and rate of shear in 3 sets of testing equipment ASTM Grease Worker and Shell Roller Test equipment, Esso Standard Oil's equipment for the pressure oil separation test; and the Lincoln Automatic Lubrigun are presented as evidence of the necessity of a comprehensive programme on the shear stability of lub greases. J. G. H.

936. Effect of streamlining on stresses in the Perkins tensile strength briquet for refined paraffin waxes. W. P. Ridenour and J. R. Bowman. *Bull. Amer. Soc. Test. Mat.*, July 1955, (207), 59–60.—The Perkins paraffin wax briquet used for the ASTM test for tensile strength of refined paraffin waxes is notable for the irregular way in which it breaks under tension, with resultant effects on the reproducibility of the test. Details are presented of investigations carried out at the Mellon Institute resulting in the introduction of a streamlined mould which largely eliminates this irregularity. J. G. H.

937. Chromatographic methods for separating bitumen into its constituents. T. Temme. *Bitumen, Teere, Asphalte, Peche*, 1956, **7** (2), 46–9.—The simple method described permits rapid bitumen separation, on 5-g samples, into 4 distinct groups of constituents—asphaltenes, transparent oils, dark oils, asphalt resins—with selective solvents. Steps sketched and apparatus illustrated. Changes in chem structure in use are indicated. R. T.

GAS

938. History of natural gas development in Saskatchewan. H. B. Holmberg. *Canad. Min. metall. Bull.*, 1956, **49** (526), 87–90.—From 1900 to 1933 only 56 wells had been drilled in the Province. In 1934 the first successful gas well was completed, but the first oil discovery was not made until 1943. By 1954, 2724 wells had been drilled, of which 142 had been completed as gas wells, 1140 as oil wells, and 1347 were abandoned. From statistics available it appears that the footage drilled in 1955 will prove a record. Details of the main fields in the Province are given. 7 figs, 1 table. M. P. T.

ENGINE FUELS

939. Combustion developments discussed. Anon. *Oil Eng.*, Nov. 1955, **23** (269), 256.—Article describes briefly some of the papers read to the IME and ASME Joint Conference on Combustion. The papers described are: "High-compression Turbocharged Spark-ignition Gas Engines," by W. M. Kauffmann; "Combustion Products and Wear in High-speed Compression-ignition Engines, with Particular Reference to the Use of Lower Grade Fuels," by W. T. Lyn; "Combustion in Large Diesel Engines," by P. Jackson; "Combustion in Precombustion-chamber Engines," by H. Hoffmann; "The Lanova Combustion Process—a Brief Description of its Development and Function," by H. Lang; "Design Notes on Swirl Chamber Engines," by O. Cordier; "Combustion in Dual Fuel Engines," by N. P. W. Moore and R. W. Stuart Mitchell; "Surface Ignition in a Motored Engine," by J. C. Livengood, T. Y. Yoong, T. P. Rona, C. F. Taylor, and I. A. Black; and "Combustion in Petrol Engines," by M. R. Vichnievsky. The discussions are also very briefly reported. C. B.

940. The combustion of liquid fuel spray. J. A. Bolt and T. A. Boyle. *Trans. Amer. Soc. mech. Engrs*, Apr. 1956, **78** (3), 609.—The paper is concerned with combustion of liq fuel sprays, of the size usually found in aircraft gas turbine combustors. A spinning disk was used to produce uniform-size fuel drops of 70–130 μ dia. Rates of burning of several liq fuels were determined. Photographic techniques were used

to indicate the rate of change of dia and the velocity of burning drops while moving freely in air. 10 literature refs and one page of discussion are given. C. B.

941. Technical note concerning the structural retardation factor. F. Mauss. *Rev. Inst. franç. Pétrole*, 1956, **11**, 109–12.—Discussion, based on the literature and developed from the views of Livingston (*cf.* Abs. **1146**, 1952), of relationship between oxidn resistance and O.N. of hydrocarbons. V. B.

942. Tackling the residual fuel problem. Pt IV. Anon. *Oil Eng.*, Nov. 1955, **23** (269), 280.—Shell experience using residual fuels in the *Auris* gas turbine is briefly described. The effects of additives such as kaolin and metallic oxides to combat corrosion, and the influence of kaolin and ethyl silicate on ash deposition are described. A later article—*Oil Eng.*, Feb. 1956, **23** (272), 380—reviews the *Auris* seagoing experiences over 4 years. At Pametrada the use of powdered siliceous additives to reduce fouling has been investigated, and methods of blending of fuel and additives are discussed. 9 literature refs are given. C. B.

943. The influence of some chemical and physical factors on the formation of deposits from residual fuels. P. T. Sulzer. *Trans. Amer. Soc. mech. Engrs*, Oct. 1955, **77** (7), 995.—Discusses the occurrence of oil–ash deposits in industrial gas turbines, and the mechanism of the build-up of deposits. Physical and chemical features of deposits are considered. Correlations are made between ash deposition and conditions of temp, pressure, excess air, fuel–ash content, and test duration, and a formula is given. 12 refs. C. B.

GAS OIL AND FUEL OIL

944. Railroads may adopt new fuel pattern. D. H. Stormont. *Oil Gas J.*, 20.2.56, **54** (26), 84.—Southern Pacific Railroad is using a dual-fuel system on its locomotives, allowing switch from diesel to residual type fuel during medium and high load conditions. The mechanism is controlled by a governor relay which switches fuel feed to residual between fourth and fifth throttle positions. The tests are of interest to petroleum refiners, as if successful, demand for diesel fuels will fall and price of residuals might rise. G. A. C.

LUBRICANTS

945. Studies in lubrication. XI. Slider bearing with transverse curvature—exact solution. A. S. C. Ying, A. Charnes, and E. Saibel. *Trans. Amer. Soc. mech. Engrs*, April 1956, **78** (3), 465.—The Reynolds equation in the hydrodynamic theory of slider-bearing lubrication with side leakage, for film thickness varying exponentially both in the direction of motion and symmetrically perpendicular to this direction, is considered, and an exact solution is derived. It is a rapidly convergent series, and permits ready calculation of pressure distribution, total bearing load, frictional force, etc., for all length-to-width ratios, all entrance-to-exit clearance ratios, and all centre-to-side clearance ratios. The solution is found to be as easy to apply as the former approx method, which was found to be quite accurate for small ratios of centre-to-side clearance. With larger ratios, errors in the approx method became apparent. The exact solution is recommended for practical use. C. B.

946. Miles per quart +. 2. Additives. J. M. Nuttall. *Sci. Lubric.*, Jan. 1956, **8** (1), 19–20.—Types of lubricant additives specially adapted for automotive use are enumerated with characteristics, functions, and methods of test. J. G. H.

947. Extreme pressure lubrication. W. Davey. *Sci. Lubric.*, 1955, **7** (6), 23–7.—The development and functions of EP lubricants for use with automotive gears and in metal working operations are briefly surveyed and the mechanism of EP lubrication explained. The 4 main groups of cpds possessing EP activity, organo-metals, sulphur and selenium, halogens, and phosphorous cpds are discussed in some detail, with notes as to their mode of operation. Relations between chemical constitution and EP activity are considered and details of mechanical test methods presented. J. G. H.

948. Modern lubricants from a modern plant. E. L. Sutton. *NLGI Spokesm.*, May 1955, **19** (2), 6–13.—Fully illustrated description of Pure Oil's grease and lub oil plant at Neches River, Texas. J. G. H.

949. The cold sludge controversy. Anon. *Oil Eng.*, Nov. 1955, **23** (269), 252.—Article summarizes the opinions of leading oil companies, motor manufacturers, and operators on the subject of cold sludge. C. B.

950. Engine tests of lubricants: special meeting of IP Panel. Anon. *J. Inst. Petrol.*, Dec. 1955, **41** (384), 383.—Account of meeting held by the IP Standardization Subcommittee No. 5 (Engine Tests). A paper—"The C.L.R. Oil Test Engine"—was read by M. K. McLeod. Status reports of the Petter AVI and Gardner, Petter W1, and Engine Operators' Working Groups were given. C. B.

951. Bearing failures in electric motors. G. Larsen. *NLGI Spokesm.*, June 1955, **19** (3), 16–17.—Bearing failures are frequently responsible for the necessity of the most costly of electric motor repairs. Common causes of bearing failure enumerated and illustrated include over-lubrication, lack of lubrication, contamination of lubricant in bearings, misalignment of motor, misalignment of bearings within motor, and excessive belt or chain tension. J. G. H.

952. Journal and thrust bearing practices on large rotating electrical machines. R. A. Baudry and B. B. Winer. *Lubric. Engng*, Nov. 1954, **10** (6), 327–35.—Deals with hydrodynamic thrust and journal bearings on machines rated at higher than 100 h.p. Points covered include unit loading, lubrication, bearing materials, methods of supporting bearings, oil seals, calculation of bearing performance, and insulation of bearing currents. 23 refs. J. G. H.

953. Effect of air and nitrogen atmospheres on the temperature limitations of liquid and solid lubricants in ball bearings. Z. N. Nemeth and W. J. Anderson. *Lubric. Engng*, July–Aug. 1955, **11** (4), 267–73.—The steady increase in operating temp in aircraft turbo-jet engines continually accentuates the problem of providing adequate lubrication for the bearings, for which the provision of solid lubricants or of inert atm have been put forward as solutions. Details are presented of an investigation of these possibilities using a special bearing rig which is described and illustrated. The procedure employed is outlined, and results obtained indicate that solid lubricants (molybdenum disulphide and graphite) were best in either air or nitrogen atm, and both graphite in air and molybdenum disulphide in nitrogen were effective up to 1000° F. While silicone diester oils were effective up to 1000° F in nitrogen, heavy carbonaceous deposits prevented free rotation on cooling to room temp. J. G. H.

954. Oil-soaked felt pad lubrication of ball bearings at high speed and high temperature. H. S. White, J. F. Swindells, and H. V. Belcher. *Lubric. Engng*, May 1955, **11** (3), 182–6.—Conventional methods for lubricating pre-lubricated ball bearings have proved unsatisfactory in some aircraft applications by reason of excessive starting friction at low temp and poor stability at high temp. Data are presented on an extensive series of investigations using felt rings saturated with oil, the felt functioning instead of soap or thickener to supply oil slowly to the bearing without further addition of oil to the felt. The apparatus and procedure employed are described in detail, and results obtained with a wide range of lubricants are tabulated and discussed. These indicate that an oil-soaked felt pad, using di (2-ethylhexyl) sebacate as lubricant with the addition of a mild EP anti-wear additive should

prove most suitable for long-time lubrication up to 325° F. For higher temp it would probably be necessary to replace the felt with metal, glass, or suitable plastic fibres. J. G. H.

955. Measurament of lubricant thickness on powder-metallurgy dies. N. P. Pinto. *Lubric. Engng*, Nov. 1954, **10** (6), 336–9.—The necessity of an accurate method of measuring lubricant thickness in the lubrication of die walls of dies used in production of powder-metal compacts is remarked, and a review of possible methods indicates the superiority of the air gauge system for this purpose. Equipment and procedure used are described and illustrated, and advantages and further applications indicated. J. G. H.

SPECIAL HYDROCARBON PRODUCTS

956. Dielectric losses of oil–resin mixtures at low temperatures. M. Beyer. *Elektrotech. Z. (A)*, 1956, **77**, 161–6.—Measurement of loss factor (tan δ at 10 kV/cm, 50 Hz, Schering bridge, description and sketch of cell, accuracy $\pm 1 \cdot 10^{-4}$) for oils and oil–resin mixtures in visc (50° C) range 4°–240° E and at temp −50° to +80° C shows that position of max on loss factor–temp curve is visc-governed, being displaced towards higher temp with increasing visc. Loss factor can be either increased or decreased by resin addition, depending on nature of mixture components. An expression is derived for visc-dependence of position of max loss factor, such expression is valid for various oils and for resin contents up to 23%, provided that mean dipole moment of mixture $\geq 0 \cdot 5$ Deb, presence of impurities does not affect validity of expression if this dipole moment max is not exceeded. Measurement of the dielectric const–temp curve shows this to have a break (dip) at a temp corresponding to set. pt. of mixture. V. B.

DERIVED CHEMICAL PRODUCTS

957. Trends in glycerine. E. S. Pattison. *Soap, N.Y.*, 1956, **32** (3), 43.—General paper discussing the position of glycerine in the American market. Production figures are given, and the possible future position is considered. D. K.

CORROSION

958. Pointers on basic corrosion control. R. G. Deering. *Oil Gas J.*, 26.3.56, **54** (47), 159.—Some questions dealt with and answered at the short course sponsored by the National Association of Corrosion Engineers at Tulsa are given, and include pipe cleaning, coating, corrosion, and measuring techniques. G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT

959. Dynamics in the inlet system of a four-stroke single-cylinder engine. C. F. Taylor, J. C. Livengood, and D. H. Tsai. *Trans. Amer. Soc. mech. Engrs*, Oct. 1955, **77** (7), 1133.—Describes the improvement in volumetric efficiency of a 4-stroke single-cyl engine which can be obtained by careful design of the inlet pipe and correct valve timing. The effects of inlet-pipe length, dia, and inlet-valve timing and other design parameters were studied. The results showed that the dynamic effect of the inlet pipe on volumetric efficiency was associated with: (*a*) the action of the standing wave set up in the air column during the preceding cycle, and (*b*) the process of accelerating the inlet-pipe air column during the first part of the inlet stroke and taking advantage of the ramming of the air column during the last part of the same inlet stroke. 9 refs. C. B.

960. Causes of knocking in the gasifier and diesel motor and its restraining significance for their modern trend of development. E. Terres *et al. BrennstChemie*, 1956, **37** (3–4), 33–41.—Adiabatic ignition temp of *n*- and *iso*-paraffinic, olefinic, aromatic, and naphthenic hydrocarbons, also alcohols, ethers, and ketones lying in the boiling range of motor fuels are investigated. Kinetic investigations of hydrocarbon oxidn in the gas phase are made. Experiments—described—on adiabatic ignition temp do not substantiate the theory of formation of a pressure and heat wave which postulates a very high adiabatic ignition temp for the very knockproof *iso*paraffins in contrast to *n*-paraffins of the same mol size. Motor suitability of hydrocarbon groups is judged by measuring reaction velocities in slow oxidn with O_2 from 150° to 300° C, and by measuring combustion velocities in air mixture in dependence on initial pressure and temp. Velocities are referred to *n*-pentane = 1. Results show the O.N. and therewith the crit C.R. to be higher as the oxidn rate is smaller. Combustion velocities of hydrocarbon–air mixtures in dependence on initial pressure and temp show knocking to be due to too high combustion velocities. O.N. is defined as crit C.R. in which fuel reaches combustion velocity 25 m/sec max. If C.R. be increased above this crit val knocking occurs in all fuel components. Knocking in the gasifier motor is conditioned by fuel structure and material, but not in the diesel motor, where it is caused by ignition of fine liq fuel drops saturated with O_2 under existing pressure and temp conditions. Fundamental questions of development of gasifier and I.C. motors regarding greater independence of fuel composition are discussed. R. T.

961. The industrial gas turbine (using natural gas). Anon. *Petrol. Times*, 13.4.56, **60** (1531), 235–6. 105,322 M.c.f. of natural gas obtained in 1954 from newly drilled wells in the Po Valley was treated and distributed via Cortemaggiore. The Ruston T.A. gas turbine was developed as part of a power unit to utilize this source of natural gas. The installation is illustrated and construction described. Main units are the simple open-cycle gas turbine, output 1200 h.p.; axial flow compressor with full load rotation of 11,500 rev/min providing compressed air for combustion chamber, viz. 2-stage compressor turbine and 2-stage power turbine together with generator. Gas turbine rating is approx 870 kW, and it had run for some 3000 hr up to the end of 1955. S. L. C.

MISCELLANEOUS

962. The economic impact of oil on the Arab Middle East. Pt III. The effect of the companies. J. Murray. *Inst. Petrol. Rev.*, Apr. 1956, **10** (112), 109.—The presence of oil companies in the Middle East has meant vast sums of money spent (approx £8 million p.a. in Iraq for the last 4 years) and a large direct source of employment. The industry, starting as a pioneer, is now becoming integrated into the life of the community. Local enterprise is encouraged to supply essential commodities, and soap, fats, and waxes are sold, thus setting up a 2-way trade. Manufactured imports often involve a merchant, who draws profits. All forms of transport are developed, providing an assured source of revenue.

Contractors, civil engineers, and builders are constantly in demand. Prices for labour are made real, and supervision promotes good workmanship. S. L. C.

963. Seasonal variations in oil demand and their effects on oil operation. Various. *Inst. Petrol. Rev.*, March 1956, **10** (111), 60–6.—Symposium on seasonal variations in oil demand and effects on oil operation. Includes 10 charts covering the period from 1938 to 1955 (the post-war period in detail), and mentioning individually motor spirit, burning oil, vaporizing oil, and gas–diesel oil. S. L. C.

964. United Kingdom petroleum legislation in 1955. V. Biske. *Petrol. Times*, 13.4.56, **60** (1531), 233–4.—Chief of the oil Acts of the year is the Oil in Navigable Waters Act 1955, which restricts the discharge of heavy oil within a zone up to 100 nautical miles from the U.K. and certain adjacent countries, S. of latitude 62° N. and 50 nautical miles from the Norwegian coast.

Further safety precautions have been introduced to cover micro-crystalline wax used in "chewing" food. Customs regulations concerning export of petroleum products and equipment now allow transit without licence to British Commonwealth, SW. Africa, Irish Republic, and U.S.A.; licences are required elsewhere. Salary dispute and decisions on appeal cases are also mentioned. S. L. C.

965. Here's a set of handy conversion factors for oil industry calculations. E. Seaton. *Oil Gas J.*, 2.4.56, **54** (48), 157.—Factors on the "this times this gives this" principle are given for a very wide range of subjects, arranged alphabetically from acres to vara. G. A. C.

966. How Ethyl keeps rein on upkeep costs. C. Resen. *Oil Gas J.*, 9.4.56, **54** (49), 86.—Pt I gives an account of preventive maintenance at the Ethyl Corpn's Houston plant, as a long-range means of lowering costs and improving efficiency over the last 4 years. The programme of job scheduling includes lubrication, pressure equipment inspection, painting, and keeping of equipment records. G. A. C.

967. Articles on the Co-ordinating Research Council. Various. *J. Inst. Petrol.*, Dec. 1955, **41** (384), 353–82.—"The Co-ordinating Research Council," by M. K. McLeod. "Current Programme of the Co-ordinating Research Council," by T. B. Rendel and W. G. Ainsley. "What the CRC means to the Petroleum Industry," by W. J. Sweeney. "What the CRC means to the Automotive Industry," by E. S. MacPherson. C. B.

968. Here's how Gulf Coast refiners conduct training programs. Anon. *Oil Gas J.*, 5.3.56, **54** (44), 86.—A series of questions on training programmes is answered, such as length of programme, instructors, and number of employers necessary to run a plant. G. A. C.

969. Effects of U.K. taxation on tanker fleet. Anon. *Petrol. Times*, 30.3.56, **59** (1530), 205.—Extracts from the Annual Report of the Liverpool Steam Ship Owner Association concerning flags of convenience, taxation, delays in the Suez Canal, and pollution of the sea by oil. G. A. C.

970. Future of synthetic liquid and gaseous fuels. H. R. Batchelder and H. W. Nelson. *Mech. Engng, N.Y.*, Jan. 1956, **78** (1), 11.—The factors which will determine the production of synthetic fuels are growth of energy demand, growth of population, supply and availability of natural fuel.

Forecasts are made of energy requirements until 1975 for the U.S.A. Graphs show energy demands for mineral fuels and water power, petroleum, and natural gas. Effect of atomic and solar energy is considered. The authors conclude that the general introduction of synthetic fuels will begin within 10 years. The next 10 years after that should show a large increase in production capacity, and in 1975 synthetic liq and gaseous fuels should be major suppliers of energy in the U.S.A. 11 literature refs. D. K.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

971. Recent trends in oil geology. Pt 1. J. C. M. Taylor. *Petroleum, Lond.*, 1956, **19** (2), 45.—The growth of geological, geophysical, and geochemical methods of exploration since the early work of Hunt and others who evolved the anticlinal theory are outlined, and some of the basic factors in oil geology are described. It is indicated that exploration techniques have developed to an extent that it is difficult to separate geology from other sciences and an increasing reliance is placed by the geologist on the technique of other industries. The principles of migration and accumulation are described, and the importance and limitations of "closure" are emphasized. C. A. F.

972. Geologist's outlook hinges on answers to three $64 questions. A. I. Levorsen. *Oil Gas J.*, 30.4.56, **54** (52),104.—The outlook for petroleum geology is reviewed in relation to future petroleum demand; this depends on the amount of future demand, whether there is enough oil to supply it, and whether it can be found. These questions are answered in a discussion which includes the future of petroleum geology and geophysics, and future possible oil provinces in the U.S.A. 5 conclusions are reached: (1) a continuing growing demand for oil; (2) an abundance of unexplored rocks in which to look for oil; (3) the possibility of economic working of currently uneconomic resources; (4) most undiscovered fields will be found; and (5) future fields will be found by geologists. C. A. F.

973. Where are the world's giant fields? G. M. Knebel and G. Rodrigues-Eraso. *Oil Gas J.*, 30.4.56, **54** (52), 113.—The geological and geographical distribution of the major oilfields of the world are described, together with their positions in the basins, the type of trap, lithology and age of reservoir, depth, and gravity and chemical characteristics of the oil. These data are analysed, the major fields (236 in all) being taken for this purpose as those having an ultimate recovery of over 100 million brl. These fields occur in 42 basins and contain 82·5% of the ultimate recovery of all known fields. The

analyses show : (1) that the stable side of a basin holds most of the oil ; (2) 80% of free world oil is in anticlines ; (3) 59% of oil in the major fields is in sand reservoirs ; and (4) the main producing formations are the Mesozoic and the Miocene and Oligocene. C. A. F.

974. Want to be first in Vermont? F. J. Gardner. *Oil Gas J.*, 26.3.56, **54** (47), 191.—Discoveries of gas S. of St Jean, Quebec, have stimulated interest in the oil possibilities of Vermont. The discoveries are in the St Lawrence Lowlands, where 3 recent wells out of *ca* 25 drilled have flowed gas in commercial amounts. The area is underlain mainly by Ordovician and Cambrian reaching *ca* 8000 ft in part of the St Lawrence overthrust ; sediments are dominantly limestone. The regional structure is a broad syncline trending NE. containing anticlines, faults, sand lenses, and NE. wedge outs. Oil seeps have been found. C. A. F.

975. Strike made 40 miles offshore. Anon. *Oil Gas J.*, 12.3.56, **54** (45), 131.—Gas dist has been found 40 miles off the coast of Louisiana by A-1 Dome A, in the Eugene Island area, which flowed 138 b.d. of 49·1° dist and 6·9 million cu. ft/day of gas from Miocene at 14,808–14,836 ft. Shallower shows were also found. The well was drilled in 85 ft of water from a self-contained stationary platform from which up to 6 wells can be drilled. C. A. F.

976. New producing-depth record set. Anon. *Oil Gas J.*, 30.4.56, **54** (52), 84.—The drilling and testing history of 1-L Humble LL & E in Louisiana are briefly described. Oil has been produced at surface on test of a Miocene sand at 21,443–21,465 ft flowing at over 500 b.d. of 38° oil ; GOR was 1200 cu. ft/brl. Several zones higher in the well are also possible pays. Deepest established production is from the Weeks Island field, also in Louisiana, where gas and condensate are produced from Miocene sand at *ca* 17,600 ft. C. A. F.

977. New look is needed in Appalachian basin. H. P. Woodward. *World Oil*, 1956, **142** (4), 96.—It is claimed that the Appalachian basin is not yet fully explored and that further exploration and intensive study are justified. The area has never been adequately prospected in the light of modern ideas and there is a need for co-operative effort and co-ordination of all geological data for the region. Certain critical areas are worthy of re-assessment and a number of fundamental problems should be studied, such as the nature of the basement complex, migration, facies changes, possible trend lines of deep structures, and the effects of overthrust faults on accumulation compared with the effects of simple folding. C. A. F.

978. Prospects for deep drilling in Alabama. S. J. Lloyd. *World Oil*, 1956, **142** (4), 102.—Deep drilling in Alabama has indicated promising results in the SE. part of the state and the adjacent offshore area. Oil was first found in commercial quantities in 1944 at Gilbertown in Selma Chalk, and several fields have since been discovered. For evaluation purposes, Alabama can be divided geologically into 4 areas. The geology and deep well drilling of each of these is briefly described. C. A. F.

979. Two strikes in McAlester–Arkansas lend wildcatters hope. F. J. Gardner. *Oil Gas J.*, 2.4.56, **54** (48), 179.—The geology of the McAlester–Arkansas basin which trends E.–W. from Coal County, Oklahoma, to E.–Central Arkansas is outlined. It contains up to 40,000 ft of beds ranging from Cambrian through Pennsylvanian, and in the shallow part around the Ozark uplift in E. Oklahoma many fields have been found in shallow Pennsylvanian sands. Due S. of the Ozark uplift in the deeper part of the basin only gas has been found in Pennsylvanian beds. Underlying Cambrian–Mississippian rocks are deep prospects. 2 recent wells on the E. and W. side of the basin have found gas in pre-Pennsylvanian rocks, but no oil has yet been found in the basin. One ref. C. A. F.

980. North Dakota's Nesson anticline. Pt 1. W. M. Laird and C. B. Folsom. *World Oil*, 1956, **142** (4), 89.—The geology and production history of the area about the Nesson anticline in N. Dakota are described. The structure is in the centre of the Williston basin and trends approx N–S. from the Canadian border to the Lower Missouri river. Closure is probably less than 100 ft, but there are superimposed structures which are structurally higher, and it is suggested that the feature is due to vertical uplift related to faulting in the basement. Rocks below the Mississippian Madison are not well known for lack of drilling data, but the Madison group has been studied fully ; it consists of the Lodgepole (base), Mission Canyon, and Charles.

A number of fields has recently been found along the anticline, the main pay being porous zones in the Mission Canyon limestone. 3 refs. C. A. F.

981. Southwest Velma stepout scores. B. O. Andress. *Oil Gas J.*, 19.3.56, **54** (46), 322.—The recent discovery of reverse faulting W. of the SW. Velma field, Stephens County, Oklahoma, has indicated the possibilities of new discoveries in the area. The geology of SW. Velma is described, and a cross-section of the field is included. The main pay is Springer sand, and the main control of accumulation is reverse faulting in association with folding. Major faulting began during early Pennsylvanian and ended before the Permian. C. A. F.

982. Desert show found. Anon. *Oil Gas J.*, 26.3.56, **54** (47), 90.—A well in the NW. part of the Sechura Desert, Peru, found a few brl of 22° oil on test at *ca* 3200 ft, but has been abandoned as non-commercial. In the Mirador area one of 2 recent wells has tested *ca* 500 brl of 38° oil. At least 16 dry holes have now been drilled in the Sechura area since exploration started *ca* 2 years ago. C. A. F.

983. Mosul gets show in Iraq test. Anon. *Oil Gas J.*, 2.4.56, **54** (48), 90.—1 Sasan, a wildcat in NW. Iraq, *ca* 25 miles SW. of Ain Zalah, found oil on test at *ca* 5400 ft. At Ain Zalah production in 1955 was *ca* 21,000 brl. C. A. F.

984. British Petroleum Co begins Gambia exploration. Anon. *World Oil*, 1956, **142** (4), 210.—A waterborne seismic survey is being carried out over 200 miles of the River Gambia in W. Africa as a preliminary to further work. C. A. F.

985. New depth record set in Asia. Anon. *Oil Gas J.*, 12.3.56, **54** (45), 136.—A wildcat at Naoholia in NE. India near the Nahorkatiya field has been drilled to below 12,660 ft, and there have been indications of oil.

In the Nahorkatiya field 8 producers and 3 dry holes have been drilled since 1953, and further wells are planned in the area. Output from Nahorkatiya and Digboi totals *ca* 8000 b.d. C. A. F.

986. Wildcat in Portugal. Anon. *Oil Gas J.*, 2.4.56, **54** (48), 82.—A third wildcat, 1 Barreiro, is to be drilled in central Portugal *ca* 6 miles from Lisbon on the S. side of the Tejo River. Of the 2 earlier wells, 1 Arruda was abandoned at 7009 ft *ca* 30 miles N. of Lisbon, and 1 Pinhal Novo, S. of the Tejo River, was abandoned at 5531 ft in 1955. C. A. F.

987. B.P. steps up exploration on Malta. Anon. *Oil Gas J.*, 26.3.56, **54** (47), 90.—Exploration is being carried out in Malta, and a stratigraphic test is being made nr Zabbar, *ca* 3 miles from Valetta. 2 locations have been sited. Geophysical surveys have been completed over Malta and the neighbouring island of Gozo. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

988. Geophysics is here to stay. H. C. McCarver. *Oil Gas J.*, 30.4.56, **54** (52), 110.—The outlook for geophysics is reviewed in relation to technical advances, economics, personnel, and applications of geophysics to geological problems. Geophysics will only remain a necessary exploratory tool if it finds

oil at a price the industry can afford, and the most successful way to achieve this is a partnership of the geologist and geophysicist to produce the most reliable and comprehensive subsurface interpretations. C. A. F.

989. Finding reefs is easy. Anon. *Oil Gas J.*, 30.4.56, **54** (52), 94.—The use of gravity surveys in locating reefs in Ohio is outlined. During the last few years over 40 of these Niagaran reefs have been found by drilling on gravity anomalies, there being a marked density contrast between the reef rock and the country rock. High frequency seismic surveys are said to be effective in mapping stratigraphic traps and experimental work carried out in Ohio has shown that the data can be obtained throughout the entire section which is of interest. High frequency surveys have already been used successfully in Oklahoma and Texas to map transitions from sandstone to shale. C. A. F.

DRILLING

990. Science and technique in Soviet Union—drilling in difficult conditions. A. Ablamowicz. *Nafta* (*Krakow*), 1954, **10**, 264–6, 286–8.—The difficulty described is caving and falling-in of the walls. This is due to swelling of the formation, and the muds here recommended are of high sp. gr. and low filtration: formations native to Tartary and Baskiria are of limey nature and flaky. Subterranean water from local devonian and carboniferous formations can be used as drilling muds. The Soviet IP showed that such waters contain Fe, Mg, and Al ions and addition of NaOH deposits these as hydroxides in cracks. This shows that each problem must be tackled individually. Sulphonic acids from edible oils, petroleum, or paper industry are useful additives, and they lower filtration, particularly in brine-bearing rock. Similar is the action of humic acids, but all these are of variable composition. There is need in USSR for standardization of such by-products and perhaps co-operation between producer and petroleum industry. Muds based on crude oil are coming into use. Excessive filling of cracks interfered with production. (From M. A. Gyeyman, *Neft. Khoz.* May 1954.) Additionally (*Neft. Khoz.*, Sept. 1954) comes news of increasing use of turbovert (turbo-drill) and of rise in power available for drilling. M. S.

991. Transportable rotary drilling rig for 80 m "J. L. 7 Rudno." S. Karlic. *Nafta* (*Krakow*), 1954, **10**, 276–82.—This follows models "J. L. 35–Rudno" and "J. L. 5–Rudno" and has a twin motor, ancillary equipment, and a mast 21 m high capable of holding 30 tons. It is an adaptable unit and is described with several drawings and photographs. M. S.

992. Pressure (exerted) on the bottom of small diameter well by drilling. R. Piatkiewicz. *Nafta* (*Krakow*), 1954, **10**, 252–4.—Author analyses the mechanism of small dia drilling which is common in USSR. Effectiveness depends on pressure, speed, and mud velocity. Pressure from above may bend the string of tools, so heavier pipes should be nearest to the bit. M. S.

PRODUCTION

993. Formation evaluation—is it worthwhile? H. T. Wright and L. D. Wooddy. *World Oil*, 1956, **142** (4), 154.—The application of formation evaluation techniques in the Seeligson and Borregos fields, Texas, is described and their values assessed in the development of the fields. The fields contain substantial oil reserves and cover *ca* 65,000 acres; reservoirs are lenticular sands in anticlinal structures modified by faulting, and drives include dissolved gas, gas cap, and water. Data for evaluation came from production and pressure data, core analyses, well logging, and drill-stem test results. It is concluded that these techniques have been reliable in determining the properties of the reservoirs and that their application has been justified in determining optimum conditions for operations. C. A. F.

994. Formation samples indicate low resistivity on electric log—could mean chert. A. H. Heim and H. W. True. *World Oil*, 1956, **142** (4), 126.—Low resistivities commonly shown on electric logs through "Mississippi chert," which in places produces important amounts of oil, have been investigated and the results of core analysis of the material are described. The rock is a mixture of microcrystalline quartz and siliceous shale, and porosities up to 40% and formation factors down to 5 were recorded. It is concluded that the low resistivities can be attributed to high average porosities and water salinities with possibly some interbedded shale. Porosity and permeability may very considerably over short distances, and locally the chert is vugular and fractured.

Material was obtained from wells in Oklahoma and Kansas. C. A. F.

995. Special logging package saves $1000 per well. J. D. Owen. *Oil Gas J.*, 23.4.56, **54** (51), 109.—In the Quinduno field, Texas Panhandle, it has been found that quantitative interpretation of γ-logs, laterologs, and micrologs provides data for the dolomite reservoir as accurate as that from core analysis, thus eliminating much drill-stem testing, coring, electric, neutron, and micro-logging. A saving of approx $1000/well has been effected.

The theory and methods of log analysis are described, the basic principles of electric log interpretation being used. Examples of typical log analysis are given, with specimen γ-, latero-, and micro-logs. C. A. F.

996. Permanent-type dual completions find favour. Pt 1. G. H. Tausch and J. W. Kenneday. *Oil Gas J.*, 2.4.56, **54** (48), 104.—Dual completion of wells in recent years has been favoured by increased drilling costs, limited allowables, and the relatively low additional cost of the second completion, but the technique has increased workover costs, with problems of sand exclusion and artificial lift. Workover costs can be reduced by permanent dual completions in which one or both zones can be reworked by wire-line, and there is a substantial saving in costs. Completion can be carried out to permit tools to be admitted through the tubing, and in recent completions parallel tubing strings have been used.

Equipment and techniques are described with diagrams, and 6 refs are included. C. A. F.

997. Condensates in gas wells. A. Stec-Kulczycka. *Nafta* (*Krakow*), 1954, **10**, 259–62.—The problem attempted by the Polish IP has been to explain the nature of the well-bottom condensates as well as the removal and sand which caved in at the bottom of the well. 12 wells were examined. Hydrocarbons as well as moisture were found. Well-bottom pressures in all cases are too low for all the heavier hydrocarbons to dissolve in the gaseous phase (Leverty), and retrograde condensation is at max. This is the first attempt at better understanding of this kind of well. M. S.

OILFIELD DEVELOPMENT

998. U.S. and Canadian reserves greater than ever before. Anon. *World Oil*, 1956, **142** (5), 100.—More oil and gas was discovered in the U.S.A. and Canada in 1955 than was produced. U.S. reserves of liq petroleum increased by 645 million brl to a total of 35·4 billion brl. 3·3 billion brl of new reserves were found during the year, but 2·7 billion brl were produced. Gas reserves increased by 12 trillion cu. ft. to a total of 223·7 trillion cu. ft. In Canada reserves of oil and natural gas liq increased in 1955 by 341 million brl to a total of over 2·7 billion brl. 470 million brl were found, and 130 million brl were produced. Tables show estimated proved U.S. reserves of liq hydrocarbons annually since 1936, estimated proved reserves of liq hydrocarbons in the U.S.A. and Canada by areas and by states, and estimated proved reserves of natural gas in the U.S.A. by years since 1945. C. A. F.

999. Russell pool gets its second wind. F. Stephens. *Oil Gas J.*, 12.3.56, **54** (45), 113.—A water flood project in the Russell field, New Mexico, is described: this project follows a gas repressuring operation which was estimated to give a recovery

of *ca* 25% of oil in place. The water flood is expected to give an increased recovery of up to 50% of original oil in place.

The field was found in 1942, and by Sept. 1955 there were 20 producing wells, 7 active gas-injection wells, and 19 water injection wells. The pay is Permian Yates sand at *ca* 800 ft, and the reservoir is a stratigraphic trap on the SE. flank of a regional nose. Oil gravity is 36°–38°. A location map and charts showing production increases due to injection are included. C. A. F.

1000. Nevada still promising but unproved. W. T. Smith. *Oil Gas J.*, 2.4.56, **54** (48), 181.—Only 3 wells are producing oil in Nevada in the Eagle Springs area of Nye County, although in the E. part of the state there are favourable structures, seeps, source rocks, and reservoir rocks. Exploration to date has been disappointing in spite of active drilling and geophysical work.

Oil was discovered at Eagle Springs in 1954, where a well was completed for pump production at *ca* 6500 ft in Tertiary volcanics. 2 subsequent wells in the area found oil respectively in Tertiary limestone at *ca* the same depth and in Palæozic limestone at *ca* 7000 ft. Crude quality is similar in each zone. C. A. F.

1001. More oil from fractured shale pool. D. H. Stormont. *Oil Gas J.*, 12.3.56, **54** (45), 111.—The Antelope shale zone of the Buena Vista Hills field in San Joaquin Valley, California, is being unitized in order to increase ultimate recovery by eliminating wasteful drilling. The zone was discovered in 1952, and the interval open varies from *ca* 415 to 1450 ft. Production is controlled by fracture development, and the best wells are mainly along an anticlinal crest where the fractures are better developed. Drive is believed to be solution gas, and there is an irregular inclined water table. The average initial production of recently completed wells was approx 200 b.d. of 32° oil. C. A. F.

1002. Deep drilling planned in Japan. Anon. *Oil Gas J.*, 16.4.56, **54** (50), 138.—Geological and geophysical work carried out in Japan during the occupation has been expanded, and a further wildcat drilling programme has been planned and there may be some offshore work. The deepest well in Japan is at 5580 ft in Yabase field in NW. Honshu, discovered in 1934. The oldest field, Higashiyama, was found in 1893. C. A. F.

1003. Soviet says its drilling, crude yield, reserves up. A. J. Steiger. *World Oil*, 1956, **142** (4), 195.—New discoveries in Russia are reported between the Volga and the Ural Mts in the Second Baku area. Reserves in the area are estimated as high as 10 billion brl.

Oil production in Russia in 1954 is estimated at 365 million brl, of which 60% came from E. fields. At Bashkiria in the centre of the Second Baku area production has increased rapidly, but there are transport difficulties which are hindering development. C. A. F.

TRANSPORT AND STORAGE

1004. Tomorrow's oil pipelines. J. L. Burke. *Pipe Line News*, 1956, **28** (4), 35–7.—The development of pipelines over the past 50 years and their place in the future is discussed. The uses of automatic control, microwave telemetering, corrosion control, electronic computers, and radio-active isotopes are described. D. B. S.

1005. Civil engineering in pipeline construction. S. D. Bechtel, Jr. *Pipe Line News*, 1956, **28** (3), 23.—The part played by the civil engineer in a new pipeline project from its conception to completion is discussed. The project may be divided into 2 phases: first, management, which encompasses economic considerations, route location and mapping, right-of-way acquisition, design, material procurement, and inspection of construction; and second, the physical construction of the pipeline. D. B. S.

1006. Vent gas problem is solved by Natural Gas Storage Company. R. E. Evans and J. E. Thompson. *Pipe Line News*, 1956, **28** (4), 41–6.—The leakage of gas from underground storage fields into water wells and abandoned oil wells is a serious problem which may often be difficult to trace and rectify. A counter measure is to drill relatively shallow wells into the upper strata and to recompress and return the vent gas to the main field. The system at the Herscher field nr Chicago is described in detail. In this field the vent gas is mixed with large quantities of water and hydrogen sulphide picked up in its migration. Water is separated and re-injected to the middle strata, and hydrogen sulphide and CO_2 are stripped from the gas by a monoethanolamine desulphurization plant before it is re-injected into the lower strata. The aux equipment on this plant, which will handle 10,500,000 cu. ft./day of leakage gas, is also described. D. B. S.

1007. Liquid removal maintains life efficiency of gas lines. A. W. Rifenburgh. *Pipe Line News*, 1956, **28** (4), 30.—The presence of condensed hydrocarbons and sludges in gas pipelines can cause breakdown at compressor stations due to the dilution of the compressor lubricant. The methods available for the internal cleaning and drainage of pipelines are discussed, but the best solution to the problem is to effect complete removal of undesirable constituents at the input end of the pipeline. This may be achieved by 2 methods, refrigeration and absorption, both of which are described in detail. D. B. S.

1008. How T.G.T. cuts operating costs. O. H. Moore. *Oil Gas J.*, 7.5.56, **54** (53), 119.—Tennessee Gas Transmission Co has reduced operating costs by supercharging to increase engine h.p., scavenger air cooling, higher C.R., and improved piping. Compressor cyl have been selected with special reference to clearance vol. G. A. C.

1009. New concept in compressor drive is tested by Transco. E. Sterrett. *Pipe Line News*, **28** (3), 33–7.—A new gas pipeline station is described in which a 16-cyl 3000-h.p. gas engine fed from the main pipeline drives the centrifugal compressor through at 10 : 1 herringbone step-up gear. The engine, compressor, and aux units are described. D. B. S.

1010. Checking water vapour concentrations in flowing gas streams. Anon. *Pipe Line News*, 1956, **28** (3), 28.—A new continuous automatic method for recording low concn of water vapour in air or gas streams has been developed. The principle of operation of the instrument is based on the heat energy exchanged when a gas is adsorbed or desorbed from the surface of a solid adsorbent. The instrument described has a full-scale range of 100 p.p.m. water by vol, but it appears that it will operate successfully at lower or higher concn. The sensitivity is 0·25 p.p.m. by vol, and the accuracy is limited by noise level and calibration errors to *ca* 1 p.p.m. Correction factors for water vapour in gases other than air are discussed. D. B. S.

1011. Technique for measuring pipe coating resistance, flange and casing-to-pipe resistance with insulating flanges. L. F. Heverly. *Pipe Line News*, 1956, **28** (3), 38–41.—Pipe to soil potentials at each end of the test section may be measured with a high-resistance voltmeter connected between the pipe and a copper sulphate electrode, placed between 50 and 100 ft from the pipe. The test current is intermittent, the "on" period being slightly longer than the "off." The equations needed to calculate the resistance data are described. D. B. S.

1012. The world's largest motor tanker. Anon. *Mot. Ship*, March–April–May 1956, **37** (432), 22.—A description is given of the 16-knot, 34,800-ton M.T. *Ferncrest*. It was built in Sweden. It has a B. & W. type 2-stroke supercharged 10-cyl engine which develops 12,500 b.h.p. at 115 rev/min. Photographs and diagrams of the vessel are included. D. K.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1013. Recent technical developments. Anon. *Petrol. Times*, 27.4.56, **60** (1532), 292.—Devices reviewed include a diaphragm-operated control valve for process control systems, a flow indicator to check on circulation of liq, a nylon fabric tyre to eliminate vapour loss in large petroleum tanks, a new foam-making branch pipe for fighting fires in bulk quantities of liq, and an automatic basic sediment and water monitor to ensure purity of crude from wells. G. A. C.

1014. Operating problems yield to electronic brain. J. C. Schneider and R. G. Wright. *Oil Gas J.*, 16.4.56, **54** (50), 168.—The Midland exploration and production area of Shell Oil Co uses a card-programmed electronic computer to solve technical operating problems. These include gas problems, gasoline plant work, lean-oil calculation, recovery performance, flash calculation, and de-ethanizer flash calculations. G. A. C.

1015. Level measurement in granular solids. F. S. Becker. *Petrol. Engr*, 1956, **28** (2), C23–8.—When severe operating conditions are encountered, such as temp of 900°–1100° F, mechanical probes can no longer be used for level measurement. The principle and development of the Ga-getron level indicator which uses the absorption of γ-rays from a radium source is discussed. 2 other types of level indicator, both employing a capacitance principle, are described. The latter type is more accurate where a probe can be designed to withstand the operating conditions involved, while the former can be repaired or replaced without shutting down the process. J. B. S.

1016. Reactor design problem: complex reaction. T. E. Corrigan and E. F. Young. *Chem. Engng*, 1956, **63** (3), 201.—A practical problem is considered in which a low product yield is improved by a complete kinetic analysis of the process. D. J. S.

1017. Measuring water vapour in gas pipelines. Anon. *Oil Gas J.*, 23.4.56, **54** (51), 145.—A new instrument is described for continuous automatic recording of low concn of water vapour in gas streams. Methods of recording are given, and a flow diagram of the instrument is depicted. G. A. C.

1018. Optimum bubble-cap tray design. W. L. Bolles. *Petrol. Process.*, 1956, **11** (4), 72–9.—Design techniques are developed by which it is possible to achieve the optimum tray design for any specific application; selection of tray type is reviewed and design techniques proposed for downcomer, Weirs bubble-cap size, and arrangement. Other design factors tested are tray lay-out and area analyses and bubble-cap stepping. J. H.

1019. IP sampling panel comments on automatic sampling symposium. D. A. Yonge. *Oil Gas J.*, 30.4.56, **54** (52), 212.—This is a reasoned criticism of the use of automatic sampling devices and of the theory of continuous sampling. Situations in which the devices would prove inadequate are given, and include a tanker discharging 2 dissimilar products simultaneously, finished product sampling, and streamline flow of heterogenous liq. G. A. C.

1020. Continuous automatic sampling—2. F. H. Warren. *Oil Gas J.*, 9.4.56, **54** (49), 93.—In pt 2, a number of automatic sampling devices are described and discussed. These include the Gilbarco, McFarland, low-pressure, composite, propeller-type, flow responsive samplers; diagrams of the machines are given. G. A. C.

1021. How to instrument refinery boilers. R. Silva. *Oil Gas J.*, 7.5.56, **54** (53), 115.—A typical boiler instrumentation system is described, and includes units for master pressure and fuel-flow control, air–fuel ratio, air flow, flue-gas analysis, load balancing, and 2- and 3-element controls. G. A. C.

1022. New tests on castables. C. M. Vogrin and H. Heep. *Petrol. Refin.*, 1956, **35** (2), 158–62.—The results of an extensive study of high temp and process conditions on the performance of castable refractory linings are presented. The investigations covered the possible use of these materials for temp up to 2400° F in a reducing atm of carbon monoxide, hydrogen and carbon dioxide, methane, and water. The conclusions reached show that in selecting a castable refractory material for a vessel lining, it is important to check for substances in the castable which might be a cat for undesirable reactions or which react chemically with the service environment in a way to cause damage to the liner itself or to substances inside the contained equipment, for instance cat. R. L. R.

DISTILLATION

1023. Vapour-velocity effects on bottom entry trays. E. G. Ragatz and H. A. Baxter. *Oil Gas J.*, 16.4.56, **54** (50), 158.—Research has shown that entering jet velocities play little part in establishing column tray efficiencies in high-capacity columns, but dominating factor is turbulence. G. A. C.

ABSORPTION AND ADSORPTION

1024. Gas absorption calculations. S. R. M. Ellis. *Petrol. Refin.*, 1956, **35** (2), 127–31.—A graphical diagram procedure is given for the solution of problems in the selective absorption of hydrocarbon components from a multi-component gas mixture, where all the components have some degree of solubility in the absorbing oil. The proposed method uses weight or mol fractions and an uncorrected equilibrium value (K) at the mean lower temp. The difference point construction is used, and allowance is made for varying liq to gas ratios throughout the column. 3 sample problems are given and solved in detail. R. L. R.

CRACKING

1025. 100 octane gasoline by once-through Platforming. D. Read and P. C. Weinert. *Oil Gas J.*, 23.4.56, **54** (51), 105.—Data from commercial units employing Platforming processing feed stocks of Middle East and Mid-Continent origin show that 100 octane leaded reformate can be produced under once-through conditions without regeneration.

Tables show operating conditions (cat age) and yields. G. A. C.

1026. Power forming is no. 14. Anon. *Petrol. Process.*, 1956, **11** (4), 69.—Esso Research and Engineering Co have developed a new fixed-bed, cyclic process using a new platinum cat and a newly developed cat regenerating technique. The process is similar to Ultraforming and 3 Powerformers are already in operation at Baltimore, Edmonton, and Billing, Montana; 13 more are planned at Standard Oil Co (N.J.) affiliates in the U.S.A. and abroad at an expected cost of $60 million. J. H.

CHEMICAL AND PHYSICAL REFINING

1027. Influence of temperature on the refining degree of toluene. R. Riedl and J. Romovacek. *BrennstChemie*, 1956, **37** (5–6), 85–90.—Explanation of the influence of high temp towards deterioration of pure toluene is attempted. Crit judgment of the refining testing of pure toluene shows the results to depend on many factors, chiefly temp and agitation intensity. Deterioration of pure toluene quality in summer probably arises from autoxidation, which is stimulated by

diolefins with conjugated double bonds or by SO_2. Temp has an accelerating influence. By hydrogenating refining, in which oxidn initiators, also injurious intermediate oxidn products are removed, toluene of greater stability is produced than by conventional refining with conc H_2SO_4. R. T.

SPECIAL PROCESSES

1028. Studies on the Oxo process—1. S. K. Bhattacharyya and B. C. Subba Rao. *Petroleum, Lond.*, 1956, **19** (4), 119–23.—The synthesis of propionaldehyde by the reaction of ethylene, carbon monoxide, and hydrogen has been studied by the static method at temp from 100° to 200° C and pressures from 700 to 8600 p.s.i., using a number of cat compositions containing cobalt. Liq products in addition to propionaldehyde are polymer hydrocarbons and traces of acids and alcohols. Gaseous products consist of CO_2 and saturated hydrocarbons in addition to CO, H_2, and olefins. Percentage conversion passes through max as temp and pressure are increased, optimum being 150° C and 4300 p.s.i. Max yield is at a cat composition of 20% cobalt on kieselguhr. J. B. S.

1029. Process heat from nuclear reactors. R. H. Graham. *Chem. Engng*, 1956, **63** (3), 191.—The possibility of using heat from nuclear reactors in several high temp processes is discussed. The various problems to be overcome, together with tentative solutions, are given. D. J. S.

1030. Deparaffination of oil products. J. Kulcar and R. Lipovscak. *Nafta (Yugoslavia)*, 1956, **7** (3), 67–77.—Basic principles of the deparaffination of oil products are theoretically discussed. A short history of the development of the experimental, as well as applied techniques is given. Detailed descriptions of the most important methods in use with corresponding schemes are given. (Authors' abstract.)

1031. Pressure—hydrogen treating. M. Littig. *Petrol. Process.*, 1956, **11** (4), 67–8.—Pressure hydrogen treatment of naphtha is of dual importance in that the naphtha is upgraded by hydrogen reforming and hydrogen gas is produced for other chemical treating operations. The naphthas, virgin, cracked, or coker in nature, have a *cyclo*paraffin content of 20–43%, aromatic contents from 8 to 18%, and paraffin contents from 26 to 65%. A typical virgin naphtha can have its O.N. increased from 53 to 90 under hydrogen pressure which can be leaded to 97; the sulphur content is cut down to $\frac{1}{100}$ of what it was before. J. H.

1032. Hydrogen treating. J. McAfee and W. A. Horne. *Petrol. Process.*, 1956, **11** (4), 47–52.—The advent of cat reforming, producing hydrogen as a by-product, makes the use of hydrogen treating processes commercially attractive. Hydrogen treating of furnace oil dist results in reduced sulphur content and a marked enhancement of stability characteristics. Cracking stocks are made more susceptible to subsequent cat cracking and the quality of cat cracked products is improved. Hydrogen treatment of lub oil stocks results in better colour, carbon residue, and stability. Processing of whole crudes and residues in the presence of hydrogen and suitable cat accompanies an upgrading of the heaviest portion of the stock into lighter materials, with moderate coke production, and simultaneously desulphurizes resulting fractions to a considerable degree. J. H.

METERING AND CONTROL

1033. Natural gasoline and cycling plant instrumentation. E. E. Kleir. *Oil Gas J.*, 16.4.56, **54** (50), 140.—This is a 10-part discussion on new instrumentation developments in absorption, dist, fractionation, compressor control, force-balance flow transmitters, electronic temp controllers, de-*iso*butanizers-vapour pressure control, boil-away recorder, rich-oil, and absorber gas recovery. G. A. C.

1034. Control valves and capacity reduction. Anon. *Petroleum, Lond.*, 1956, **19** (2), 50–4.—Nominal size control-valve trim reductions are often specified for various applications where reduced capacity is required. In view of the serious disadvantages of some of the commonly used methods of achieving reduced control-valve capacity, this problem has been investigated from fundamental principles. J. B. S.

PRODUCTS

CHEMISTRY AND PHYSICS

1035. Eleventh annual review of unit operations in chemical engineering. Various. *Industr. Engng Chem.*, 1956, **48** (3), 467–559.—Reviews of particular petroleum interest are:

Adsorption: Considerable work has been done on fluidized charcoal adsorption processes. Data on the performance and operation of pilot-scale plants using pure components and mixtures of up to C_4 hydrocarbons are now available.

Centrifugation: The centrifuge is the only known device which will remove water, solid and semi-solid substances, metallic salts, and asphalt-like materials from heavy fuel oils so that they may be usable in diesel engines and gas turbines. Information on the application of disk and solid bowl centrifuges to this problem has appeared recently.

High-temperature distillation: The advantages have been shown of sieve and turbogrid trays over rings and bubble-caps in several applications. There have been no outstanding developments in the theory or calculation techniques, but several refinements and short-cuts have been proposed for solving multi-component dist problems.

High vacuum distillation: Work on lab-scale apparatus has shown that mol stills of 20–50 stages are practical and can be operated successfully. Industrial development with the high efficiencies available makes the future interesting.

Liquid extraction: There has been a continued interest in pulse columns and other mechanically-agitated extractors, and several papers have appeared giving data on both pilot plant and industrial scale applications. The review also covers new processes for the sweetening, de-asphalting, and dewaxing of lubricants; the extraction of aromatics from paraffin hydrocarbons; the removal of phenols and thiophenols from petroleum fractions; and the desulphurizing of straight-run oils, diesel fuels, and kerosines.

Flow of fluids: The review covers work on single phase flow of fluids in pipelines, process equipment, and porous media; multiphase flow of solid–gas, solid–liq, and liq–gas systems; mechanical design with reference to metering, pumps, and compressors.

Other reviews: The annual review also contains sections on absorption and humidification; crystallization; drying; evaporation; filtration; flotation; ion exchange; materials handling; mixing; and size reduction. D. B. S.

1036. Gas absorption mechanism in passage through a bubbler. K. Szadkowski. *Nafta (Krakow)*, 1954, **10**, 262–4.—The results of these investigations show that the larger the bubble the more slowly it rises. Frequently the average is *ca* 24 cm/sec, the theoretical value is

$$v = \sqrt{\frac{4 \times d \times g \times \Delta\rho_{L-g}}{3 \times \eta \times \rho_L}} \times \sqrt{1 - e\frac{-3 \times \eta \times \rho_L}{2 \times d \times \rho_g \times h}}$$

Coeff of absorption $K = 6{\cdot}95d^{1{\cdot}067} \times v^{1{\cdot}25} \times H^{-0{\cdot}5}$. It depends on internal movement of material in the bubble influenced by change of shape due to change from accelerated

to steady motion and by tangential tension. Another influence is due to local concn of gas already dissolved in liq, and this is affected by stirring of liq by rising bubbles. (From *J. Appl. Chem. U.S.S.R.*, 1950, **23**, 575.) M. S.

1037. More data to aid design—liquid densities over temperature range. J. O. Osburn. *Chem. Engng*, 1956, **63** (3), 197.—A nomograph shows how liq densities may be found over a temp range from a knowledge of the critical temp and the density at a lower temp. D. J. S.

1038. The use of equations of state. I. N. Canjer. *Petrol. Refin.*, 1956, **35** (2), 113–16.—The use of the mixture rules of equation of state for complex mixtures and the use of correlating factors such as molal average b.p. is discussed. Although they are simple and cannot be used at all times, to propose a more correct set of rules would increase their complexity to a point where they would no longer be of practical use for design purposes. However, as the author points out, in purely scientific work, such as analysing experimental vapour–liq equilibrium data, they should be used only with great caution. R. L. R.

ANALYSIS AND TESTING

1039. New method of grease testing. A. F. Buri. *NLGI Spokesm.*, 1955, **19** (1), 38–43.—The RIV (Italian) 3-ball tester, a new multi-purpose grease tester, is described and illustrated in detail, with notes as to test procedure and applications to research, production testing, and compatibility of different greases. J. G. H.

1040. Correlation of ASTM grease worker tests with field performance. E. M. Higgins. *NLGI Spokesm.*, 1955, **19** (9), 8–10.—The ASTM grease worker is discussed as an instrument for the control of grease consistency, and its limitations in simulating accurately the conditions obtaining in bearing operation are indicated. The need for new testing devices to cover this need is emphasized. J. G. H.

1041. Correlation of laboratory tests with field observations of grease fluidity. J. M. Stokely and S. R. Calish. *NLGI Spokesm.*, 1955, **19** (9), 12–15.—While excessive fluidity in service is generally regarded as evidence of lack of shear stability, neither the ASTM Grease Worker nor the Shell Roll Test have proved consistent in the prediction of fluidity. Conditions in service tending towards excessive fluidity are discussed, and the necessity for new tests to adequately predict service performance is emphasized. J. G. H.

1042. Factors influencing humidity cabinet test results. H. A. Hastings. *Lubric. Engng*, 1955, **11** (5), 332–6.—The present requirement of 95–100% relative humidity does not achieve constant rusting conditions in humidity cabinet corrosion testing. Details are presented of a method by which a cloud of moisture is produced and results so obtained are discussed. Much greater precision is obtained, and effects of panel preparation and type are also considered. J. G. H.

1043. Shell roll test for evaluating mechanical stability. H. A. Woods and H. M. Trowbridge. *NLGI Spokesm.*, 1955, **19** (5), 26–31.—The need for some more severe shearing device than the ASTM grease worker for evaluating the mechanical stability of lub grease is remarked, and the use of Shell Roll Tester for this purpose is described with illustrative graphs of roll tests on a variety of greases. J. G. H.

1044. Development of a method for determining the oil separation tendencies of multipurpose greases. S. F. Calhoun. *Bull. Amer. Soc. Test. Mat.*, Dec. 1955, (210), 45–9.—Present tests for the bleeding tendencies of greases are enumerated and are all considered unsuitable from a general purpose standpoint. 2 new tests, the test-tube test and the pressure test, are described in some detail and compared, the latter being considered the more satisfactory. J. G. H.

1045. Mechanical stability tests for lubricating greases. E. F. Koenig and E. M. Johnson. *NLGI Spokesm.*, 1955, **19** (5), 14–25.—The value of mechanical lab tests as screening agents in the evaluation of new formulations for lub greases is stressed, and brief descriptions with discussions of specific applications and typical results are presented for the SKF machine, the torque breakdown machine, and the vibrating wheel bearing tester. The use of the electron microscope is discussed, and the need for caution in the interpretation of its data is emphasized. J. G. H.

1046. Comparison of laboratory and field bleeding tests for lubricating greases. J. L. Dreher and A. L. McClellan. *NLGI Spokesm.*, 1956, **19** (12), 30–8.—The absence of a reliable test for the bleeding tendencies of lub greases is remarked and attributed to the lack of correlation between field and lab tests. Experiments here reported were conducted to establish a correlation between field storage tests and selected lab tests. Details of the field tests employed and of the lab tests MIL-G-3278, MIL-G-10924 (Ord), the Crater Test, and the Centrifugal Filtration Test, developed at California Research Corpn's labs are described in some detail. J. G. H.

1047. Fine hole lubricating grease worker as a rapid shear stability test. P. R. Sigler and K. Meinssen. *NLGI Spokesm.*, 1955, **19** (5), 10–13.—The need for a rapid shear stability test for the lub grease industry led to an investigation of the relationship between the ASTM worker and the fine hole worker specified in Federal Spec. VV-L-791e. Equipment and procedure used are described and results obtained indicate that, with many greases, 1000 strokes in the fine hole worker produce equivalent penetrations to 10,000 in the ASTM worker. In addition, the correlation between results on both workers could be established for any given grease, enabling the fine hole worker to be used as a rapid control test. J. G. H.

ENGINE FUELS

1048. Fuel oil additive proves its value. Anon. *Fuel Effic.*, Apr. 1956, **4** (34), 392.—The use of an additive, Carburol, to improve burning efficiency, save fuel, and reduce fouling is described. It is claimed that the additive produces a cleaner, freer running oil, thus minimizing the problems of sludge and carbon. Operating experiences of the use of Carburol in several industrial oil-fired boiler installations are described. C. B.

1049. Operation of Harland opposed-piston engines on boiler oil. Anon. *Mot. Ship*, March–April–May 1956, **37** (432), 47.—Extracts are published from the discussion on A. G. Arnold's paper "Some Experience of Vessels Equipped with Two-stroke Cycle Harland & Wolff Opposed-piston Diesel Engines Using Boiler Oil," read to the Inst. of Marine Engrs on 24 Jan. 1956. D. K.

GAS OIL AND FUEL OIL

1050. An oil gasification plant for industrial purposes. J. Grindrod. *Combustion & Boilerhouse Engng*, 1955, **9** (11), 339–40.—Article describes the Office Central de Chauffe Rationnelle (O.C.C.R.) heavy fuel oil gasifier. The combustion process is carried out in 2 stages; the first consists of gasification of the oil fuel with primary air, and the second of burning the resulting gas and finely suspended carbon in the furnace. Any liq fuel may be used, including heavy fuel, which may need preheating to give a visc of 100–150 Red. I. The operation of the gasifier and furnace is described, and the advantages of the equipment are stressed. The process is available on licence in Great Britain. The gasifier is also briefly described in *Fuel Effic.*, Apr. 1956, **4** (34), 391. C. B.

LUBRICANTS

1051. Care of lubricating oils in service. A. M. Craig. *Sci. Lubric.*, 1956, **8** (2), 30–4.—The nature of contaminants encountered in lub oil under service conditions is discussed and methods of removal are outlined, including settling tanks, emulsion breakers, filters, centrifuging, and the care of mechanical seals. The conventional lab tests for lubricants in service are enumerated and their significance briefly discussed. J. G. H.

1052. Application of industrial lubricating oils. A. M. Craig. *Sci. Lubric.*, 1956, **8** (1), 11–16.—Lubrication application systems are considered under the main divisions of non-centralized and centralized systems. The former are discussed as oil can lubrication, drop or bottle oilers, wick, pad, ring, and splash oilers. Centralized systems are dealt with as manual and fully automatic types, these being enumerated as non-circulating and pressure circulating systems. Typical applications of each type, together with limitations and points for successful operation, are presented. J. G. H.

1053. Structure of lubricating grease. I. E. Puddington. *NLGI Spokesm.*, 1955, **19** (1), 10–12.—The physical properties desirable in a grease in order that it may function effectively as a lubricant are discussed with special reference to structural characteristics. 37 refs. J. G. H.

1054. Optical studies of lubricating grease structure. B. W. Hotten. *NLGI Spokesm.*, 1955, **19** (1), 14–19.—The use and limitations of the light microscope, the electron microscope, and X-ray diffraction in the investigation of lub grease structure is discussed. The importance of size, shape, stickiness, and strength as properties of gelling agent particles is stressed, and the special suitability of the electron microscope for investigations of this nature is remarked. J. G. H.

1055. Mechanical stability of lubricating grease. J. F. McGrogan. *NLGI Spokesm.*, 1955, **19** (7), 22–3.—Problems encountered in selecting lub greases include selection of mechanical devices to evaluate mechanical stability, limits to be set on change of consistency, and limitations in present lab mechanical stability tests. Experience in field tests is reported, and differences as compared with lab tests are discussed, and the effects of such factors as water or air in greases in operation are considered. J. G. H.

1056. Chlorofluorocarbon lubricants. Anon. *Sci. Lubric.* 1956, **8** (1), 24–5.—Chemical, physical, and electrical properties, together with corrosion effects and applications of chlorofluorocarbon lubricants manufactured by ICI, are briefly described. J. G. H.

1057. NLGI tentative method for matching lubricating grease flow properties with lubricating grease dispensing pump delivery behaviour at low temperatures. Anon. *NLGI Spokesm.*, 1955, **19** (6), 10–18.—Occurrences leading to the initiation of work on the method are reported, terms used are defined, and the scope and procedures employed are discussed. The method comprises 3 phases which are explained in detail. These comprise a method of finding the most viscous lub grease that a dispensing pump will deliver through a standard NLGI restrictor at a rate of 2 oz/min, a method for determining the apparent visc of lub greases at an apparent shear rate of 200 sec^{-1}, and a procedure for combining results so obtained to determine the lowest temp at which a lub grease can be satisfactorily delivered in the dispensing pump. J. G. H.

1058. Frictional characteristics of plastics. W. C. Milz and L. B. Sargent. *Lubric. Engng*, 1955, **11** (5), 313–18.—Frictional characteristics of 17 plastics were investigated, using the modified cross cyl apparatus which is described and illustrated, the lubricants employed being dist water and a well-refined uncompounded mineral oil, with and without the addition of 5% butyl stearate as oiliness additive. Teflon and several filled Teflons proved to have exceptionally low and nearly equivalent friction coeff and to perform as well when lubricated with water as with oil. Polystyrene had dry friction values at high speed equal to those of the Teflon type, and polyethylene's friction coeff were as low as Teflon's using oil lubrication. J. G. H.

1059. Mechanical lubrication in the paper mill. B. R. Davies. *Sci. Lubric.*, 1956, **8** (2), 25–8.—Machinery employed in paper making is briefly described, and the tendency towards mechanical lubrication is remarked. The application of forced feed lubrication is discussed, and lubricating procedure with Glassoni and Eck calendering equipment is outlined. J. G. H.

1060. Correct lubrication of textile machinery—1. S. F. Chisholm. *Sci. Lubric.*, 1956, **8** (3), 12–19.—Preparation and spinning machinery for cotton processing only are dealt with in this series. General consideration of problems of correct lubrication is followed by a discussion on the functions and lubrication of preparation machinery, items covered including bale-breaking machinery, sintered metal bearings, carding equipment, and the comb box. J. G. H.

1061. Soluble oil—handle with care. A. A. Manteuffel. *Lubric. Engng*, 1955, **11** (5), 309–12.—While the importance of formulation and processing of soluble cutting oils are generally appreciated, problems connected with handling and storage conditions have hitherto received little attention. Gelling, phase separation, and skinning are discussed and remedial measures indicated, together with a consideration of emulsion preparation and problems. J. G. H.

1062. Lubrication of modern bearing-fitted sheaves, rollers, and winches for fishing vessels. J. Grindrod. *Sci. Lubric.*, 1956, **8** (3), 20–1.—Details are presented of free-running gear for fishing vessels developed by SKF with simplified and easily accessible lubrication equipment. J. G. H.

1063. Factors influencing friction and wear with solid lubricants. M. B. Peterson and R. L. Johnson. *Lubric. Engng*, 1955, **11** (5), 325–31.—Increased interest in solids as lubricants, on account of their possible use at high temp, high loads, and in inaccessible machine parts, has rendered desirable more data on their behaviour under known conditions. Details are here presented of an investigation of the factors influencing their lubricating effectiveness, using a low speed friction and wear apparatus with steel test specimens. Lubricants used, mainly in powder form, were predominantly of the MoS_2 type with some others. Moisture was found to be harmful to lubrication with MoS_2, where lubrication effectiveness improved with increasing temp. Very small amounts of abrasive contaminants were found to have a considerable effect on wear, and crystal structure proved a useful guide in selection of solid lubricants with low shear strength. It was found that mixtures of MoS_2 and oil must contain at least 10% of minor component to obtain minimum friction coeff. J. G. H.

1064. Influence of moisture on the friction and surface damage of clean metals. R. O. Daniels and A. C. West. *Lubric. Engng*, 1955, **11** (4), 261–6.—A low-speed friction apparatus for fundamental friction and boundary lubrication studies in the speed range from 0·00005 to 0·1 cm/sec is described. This apparatus, based on the Bowden-Leben equipment, is enclosed in a chamber with controlled atm, and data are presented on its use in an investigation of the effect of adsorbed moisture and bulk water on unlubricated kinetic friction and wear using a range of specially cleaned metals. From the data obtained a theory is developed explaining the influence of moisture in terms of an oxidizing reaction at the contacting asperities as they deform, and the nature of the oxidn products formed. J. G. H.

1065. Integrally sealed ball bearings. L. D. Cobb. *Lubric. Engng*, 1955, **11** (5), 340–4.—The history and development of

sealed ball bearings from 1928 onwards is discussed, and future requirements based on a customer survey are summarized as: more efficient seals with lower torque, higher bearing speeds, greater bearing load-carrying ability, −80° to +500° F bearing operational temp, and greater bearing life span. Progress towards these objectives is outlined, and it is suggested that, at the present time, bearing designers and manufacturers have outstripped lubricant manufacturers in their search for materials for high temp operation. J. G. H.

1066. Maintenance of quality in aluminum sheet rolling oils. J. O. McLean. *Lubric. Engng*, 1955, **11** (5), 337–9.—Cold rolling of aluminium calls for an oil which will not stain the rolled sheets. Specifications for oil components for this purpose are briefly discussed, and the use of a by-pass filter system charged with adsorptive clay to eliminate contaminants from the rolling oil is described in some detail. J. G. H.

1067. Significance of viscosity of fluid lubricants at high pressures. L. B. Sargent. *Lubric. Engng*, 1955, **11** (4), 249–54.—The importance of the effect of pressure on the visc of fluid lubricants is emphasized, and methods of measuring visc under pressure are summarized. Recent work on high pressure visc is reviewed, and the effects of such variables as type of crude oil, fatty or mineral oils, and synthetic oils is discussed, together with the theories of hydrostatic and hydrodynamic lubrication. The necessity for further work on the subject of pressure visc relationships is stressed; for the present, data enabling these relationships to be accurately calculated does not exist, and required visc pressure data must be determined experimentally. 18 refs. J. G. H.

1068. Atoms trace the wear. W. R. Miller and H. R. Jackson. *Lubric. Engng*, 1955, **11** (4), 238–41.—The application of tracer techniques to the study of engine wear is briefly discussed from the standpoints (U.S.) of A.E.C. requirements, personnel requirements, equipment requirements, safety features, procedure employed, sensitivity, and accuracy. Applications of the technique to the investigation of corrosive engine wear, abrasive wear, and friction wear, using the C.O.T. (Co-operative Oil Test) engine are discussed. J. G. H.

1069. Study of the sliding of metals with particular reference to atmosphere. L. F. Coffin. *Lubric. Engng*, 1956, **12** (1), 50–9.—The use of high pressures and temp in nuclear engineering has focused attention on frictional problems, and details are reported of an investigation of the factors affecting the sliding characteristics of fairly pure elemental metals. The underlying theory, apparatus, and procedure used are discussed and illustrated, and results obtained indicate that the alloying tendency of the metals has a marked effect on frictional force and surface damage. Local seizure and sliding characteristics were found to be largely affected by the type of gaseous atm encountered, sliding without local welding occurring in inert atm for those metallic couples which do not alloy. J. G. H.

1070. Progress report on silicone lubricants. H. F. Lamoreaux. *Lubric. Engng*, 1956, **12** (1), 48–9.—Earlier attempts to improve the lub qualities of silicone fluids are reviewed, the use of additives, precoating of bearings, and properties of fluid mixtures being discussed. Data are presented on the use of a chlorophenyl methyl fluid which possesses lub properties superior to any silicone formulation yet tested, and it is suggested that lubricants with an effective range of −65° to +600° F may be possible in the near future. J. G. H.

1071. Pumpability of aircraft turbine lubricants at low temperatures. E. S. Starkman and J. H. Bridges. *Lubric. Engng*, 1956, **12** (1), 43–7.—Results are reported of an investigation into the flow characteristics of a series of typical aircraft gas turbine lubricants in a simple system at temp down to −70° F. Lubricants tested included 2 MIL–O–6081B grades, a di(2-ethylhexyl) sebacate, and an SAE 10W oil with a −30° F pour point. Results so obtained indicate that laminar flow relationships were adequate for predicting flow characteristics down to pour point so long as the inlet system was so designed as to preclude cavitation. Evidence was also forthcoming that fluids with waxy pour points could be satisfactorily pumped to temp below their pour points. J. G. H.

1072. Study of fretting wear in mineral oil. D. Godfrey. *Lubric. Engng*, 1956, **12** (1), 37–42.—Details are presented of an investigation into the factors involved in fretting corrosion, using a hard steel ball vibrating in contact with a soft steel flat, and lubricants containing a variety of additives. Results obtained indicate that in the first few cycles metal is transferred to the ball to cause galling, the softer metal being scored and ploughed, the damage increasing with the no. of cycles. Wear fragments, generated at a constant rate, accumulate in the oil, surrounding the contact area, and cause the mixture to become a viscous paste which is physically displaced from the contact area, causing the fretting from then onwards to become unlubricated. In this state, rate of wear depends on relative humidity of air, max occurring at 30% relative humidity. Physical properties of the débris change with humidity and determine rate of wear. Evaluation of lubricants for fretting calls for constant humidity and avoidance of unlubricated state. J. G. H.

1073. Rheodynamic squeeze-film. F. Osterle, A. Charnes, and E. Saibel. *Lubric. Engng*, 1956, **12** (1), 33–6.—The rheodynamic lubrication theory as demonstrated by Milne is extended to the squeeze-film occurring when grease-lubricated bearings operate under thick film conditions. J. G. H.

1074. Radio-active study of the metal-cutting process. I. Finnie and E. Rabinowicz. *Lubric. Engng*, 1956, **12** (1), 29–32.—The friction and wear process along the chip–tool interface in metal cutting operations was studied by systematic variation of tool angle, depth of cut, and nature of lubricant, using a radio-active slab of copper as workpiece, enabling the tools to be checked for radio-active material pick-up on both cutting and clearance faces. Details of the equipment and procedure employed are presented, and results obtained indicate that, with sharp tools, little action takes place along the clearance face, pick-up varies linearly with depth of cut, rake angle has little effect on wear, but much on friction. While lubricants were found to drastically reduce metal transfer and to a small extent decrease coeff of friction, the lubricant which decreases wear the most does not necessarily have the greatest effect on friction coeff. J. G. H.

1075. Wear studies with radio-active gears. V. N. Borsoff. *Lubric. Engng*, 1956, **12** (1), 24–8.—Test equipment and methods evolved by Shell Development Co for detecting and measuring gear wear using radio-active techniques are described and illustrated. Tests carried out with straight mineral oils, synthetic lubricants, and E.P. additive-containing oils revealed 3 main causes of wear, scoring, abrasion, and chemical corrosion, which are discussed in some detail. Metal transfer studies supplementing these tests showed that metal transfer invariably occurs under scoring conditions, and its significance in relation to lubrication and wear mechanism is considered. J. G. H.

1076. Protective oil coatings. K. F. Schiermeier and R. W. Lewis. *Lubric. Engng*, 1956, **12** (1), 19–23.—Existing types of rust preventive opds are classified and discussed under the following headings: rust preventive oils, water displacement oils, semi-rigid soft coatings, and hard tough coatings. Factors governing selection for specific purposes are discussed, together with basic considerations in formulation and the relationship between chemical structure and effectiveness of rust inhibitors. J. G. H.

1077. Bibliography of books on lubrication. Anon. *Sci. Lubric*, 1956, **8** (1), 34–6.—Lists, with contents, price, and date of publication of British and American books on lubrication currently available. J. G. H.

BITUMEN, ASPHALT, AND TAR

1078. Bituminous shales problem in Poland. A. Kowalski. *Nafta* (*Krakow*), 1954, **10**, 270–2.—Author describes the occurrence and method of dist of shales. Apart from kerogens, nitrogen and occasionally uranium is found in them. Polish bituminous shales found near Krosno contain from 8·25 to 23·09% of combustible materials yielding from 1 kg 88 l of gas and 33 g of bitumen (or pitch). Shale from Grybow was found to be better as building material than as source of fuels, and the open cast mine was passed into the hands of the Buildings Materials Dept. M. S.

1079. Asphalt and grout packing problems. W. Goczak and A. Kemplinski. *Nafta* (*Krakow*), 1954, **10**, 282–5.—Authors recommend pipelines as ideal means of transportation, but here the limit is 2 km. Depending on hardness, asphalt can be sent in unwrapped blocks, Isopack bags, and in rail- and road-tank cars. Isopack bags require certain improvements and tank cars present a problem due to cooling, in spite of lagging. During cold weather asphalt can be transported in open drums. Wooden barrels and paper bags have failed to give satisfaction. M. S.

1080. Paving methods in widening the New Jersey Turnpike. Anon. *Rds & Str.*, Apr. 1956, **99** (44), 162.—Exact specifications for 61½ miles of new double-lane highway enabled paving operation to be carried out in one season under 4 different contractors. Constructional details, in particular the joint with existing roadway, traffic manipulation, and rainstorm hazards are discussed. S. L. C.

1081. How Virginia controls sealing quality. A. B. Cornthwaite. *Rds & Str*, Apr. 1956, **99** (4), 161.—Adhesion tests for bituminous materials are of particular importance in this work, which has prolonged the life of a large mileage of older road surfaces. Details of bitumens used, seasonal limitations, and the 2 alternative adhesion tests, together with specifications for the materials, are included. S. L. C.

SPECIAL HYDROCARBON PRODUCTS

1082. Heats of combustion of liquid *n*-hexadecane, 1-hexadecene, *n*-decylbenzene, *n*-decyl*cyclo*hexane, *n*-decyl*cyclo*pentane, and the variation of heat of combustion with chain length. F. M. Fraser and E. J. Prosen. *J. Res. Nat. Bur. Stand.*, 1955, **55** (6), 329–33.—The heats of combustion of the 5 highly purified hydrocarbons were measured with a bomb calorimeter. Results are given, and it is shown that in both the liq and gaseous states for each CH_2 group added in the *n*-alkyl side chain, the increment in heat of combustion, and in the heat of formation, is a constant, except for the first 2 members of the series. This increment has the same value for each of these series of cpds. 25 literature refs. C. B.

1083. Compressibilities of long-chain normal hydrocarbons. C. E. Weir and J. D. Hoffman. *J. Res. Nat. Bur. Stand.*, 1955, **55** (6), 307–10.—An equation $\frac{-\Delta V}{V_0} = 0{\cdot}1717 \log_{10}(2500 + P) - 0{\cdot}6272$ represents the average compressions of the hydrocarbons studied. These were *n*-$C_{16}H_{34}$, *n*-$C_{20}H_{42}$, *n*-$C_{24}H_{50}$, *n*-$C_{26}H_{54}$, *n*-$C_{28}H_{58}$, and *n*-$C_{30}H_{62}$, and measurements were made in the cryst state at 21° C, over a pressure range of 1000–10,000 atm. No significant variation in compression with chain length was observed, within the limits of experimental error, which, however, were fairly wide due to the small size of sample. The average compressibility of the hydrocarbons studied, extrapolated to one atm, was calculated to be 29×10^{-6} atm^{-1} at 21° C. 14 literature refs. C. B.

DERIVED CHEMICAL PRODUCTS

1084. Petroleum chemical processes—the production of acetylene. P. W. Sherwood. *Petroleum, Lond.*, 1956, **19** (4), 135–9.—High temp cracking of light hydrocarbons has been established as an economically useful process for acetylene manufacture, and is now a major competitor to the calcium carbide route. Local conditions decide whether the partial combustion process, thermal cracking, or electric discharge is used. Each method is considered in detail: all yield acetylene in a 8–16% concn, and purification is by absorption in water, dimethyl formamide, or by the hypersorption process. J. B. S.

COAL, SHALE, AND PEAT

1085. Wet oxidation of coal. B. Jüttner. *BrennstChemie*, 1956, **37** (5–6), 70–4.—To obtain well-defined decomp products oxidn must take place in a liq—preferably aq—phase. Cont in products rises to 50%, in dry preoxidn the max is 30%. Various wet oxidn processes are compared. Pressure-free oxidn with HNO_3 and decomp under pressure are described more closely. Influence of carbonization degree, structural constituents, and previous oxidn of the coal on yield and properties of carboxylic acids obtained are investigated. Oxidn products from open-burning and fat coal show differences. This is clarified by further decomp. Attempts to separate the high-mol portions are not completely successful. Pure acids may be obtained by secondary reactions. However, high yields of pure esters are obtained by pressure esterification of the whole carboxylic acid mixture, separating the high-mol portion, and subsequent vac-dist. R. T.

1086. Coal improvement and operational technique. D. W. van Krevelen. *BrennstChemie*, 1956, **37** (5–6), 65–70.—Coal improvement is discussed—with explanatory charts—for household fuel, raw material for the metallurgical industry, and raw material for the chemical industry. Petroleum presents an economic menace in chem industry as a source of all coal chemicals. Yields are often greater. Production of synthesis gas and calcium carbide directly from coal in a tapping furnace is important. 8 refs. R. T.

MISCELLANEOUS PRODUCTS

1087. Solubilization with amphiphilic compounds. P. A. Winsor. *Mfg Chem.*, 1956, **27** (3), 89; **27** (4), 130.—Amphiphilic cpds have remarkable solvent properties; they are able to bring water-insoluble organic cpds into soln in water and the reverse process. Various aspects considered in Pt 2 are the aq visco-elastic properties of soaps produced in the presence of inorganic salts, soln of amphiphilic cpds in hydrocarbons, and the ways in which constitutional factors affect solubilization of water and water-immiscible organic cpds. 4 literature refs. D. K.

1088. Some physical characteristics of epoxy resin films. T. F. Bradley. *J. Oil Col. Chem. Ass.*, 1955, **38** (12), 752.—Amine-cured epoxy resins, both as films and as a bulk plastic, possess higher tensile and flexural strength than any other non-orientated resin or plastic; they maintain their strength from −40° to +25° C or slightly higher, but *ca* +40° C they begin to soften. These resins have a very small vol change during cure; they exhibit smaller coeff of expansion than do drying oils, cellulosic, and other aliphatic-type films and plastics. Adhesion data are discussed, as also are water resistance, water-vapour permeability, and chemical resistance. D. K.

CORROSION

1089. Status report of NACE Technical Unit Committee T-1J on oilfield structural plastics. *Corrosion*, 1956, **12** (3), 73–6.—Long-term strength of cellulose acetate butyrate is discussed, and a report on service experience of plastic tanks is given. Cracking-type failure is believed to result from eccentric loading that comes from filling and emptying the tank, the cracks generating from irregularities or wrinkles in the glass. If the theory is true, cracking-type failure can occur with tanks fabricated from any resin system, and probably can be eliminated only by careful glass handling and control by the tank fabricator. W. G. R.

1090. Field practices for controlling water-dependent sweet oil well corrosion. Technical Unit Committee T-1C. *Corrosion*, 1956, **12** (3), 149–53t.—The field practices used by 19 companies for controlling corrosion are reported. Limits at which corrosion becomes detrimental are given in terms of percentage water produced, iron concn, coupon corrosion rate, percentage wall reduction, and frequency of equipment failure. Reports are given of the use of injection valves, sidedoor chokes, tapered tubing, and special equipment on flowing wells, in addition to giving consideration to the minimizing of corrosion in gas lift wells and in pumping wells.

Accounts of the use of plastic coated and special alloy tubing are given, and the use of liq inhibitors, weighted inhibitors, stick inhibitors, pellet form inhibitors, inhibitor choke, and special techniques are discussed. W. G. R.

1091. Corrosion of gasoline engine exhaust valve steels. C. H. Allen and M. J. Tauschek. *Corrosion*, 1956, **12** (1), 39–46t.—The corrosive environment surrounding the exhaust valves in gasoline engines is considered, and a method of evaluating the corrosion resistance of exhaust valve steels is given. The effect of alloy composition, including the influence of silicon, on corrosion is mentioned, together with the effect of a variation in Ni–Fe content on aircraft valves and the use of valve rotators in reducing exhaust valve corrosion. W. G. R.

1092. Oxide films on stainless steels. T. N. Rhodin. *Corrosion*, 1956, **12** (3), 123–35t.—Oxide films on stainless steels have been classified into 3 types according to the thickness, structure, and composition of the film, and the influence of the film on resistance to corrosion.

The influence of corrosion in various media was correlated with film compositional properties. Composition of films after immersion in acids was found to be related to film composition prior to immersion. The effect of immersion depended on the nature and intensity of corrosion, and was reflected most sensitively by the iron and silicon contents of the films.

The conclusion was made that film properties indicate strongly the capacity of austenitic stainless steels to develop corrosion-resistant surfaces in certain environments. W. G. R.

1093. Tentative recommended specifications and practices for coal tar coatings for underground use. Technical Unit Committee T-2G. *Corrosion*, 1956, **12** (1), 75–6.—Recommendations are given for practices to be adopted in the use of coal tar coatings for buried pipelines. W. G. R.

1094. Final report on four annual anode inspections. Technical Unit Committee T-2B. *Corrosion*, 1956, **12** (1), 47–58t.—4 test ground beds were installed so that comparative data could be obtained concerning the performance of steel, carbon, and graphite anodes in both natural soil and carbonaceous backfill. As a result of annual inspections for 4 years it was found that graphite anodes in a carbonaceous backfill gave the best results. W. G. R.

1095. Correlation of the results obtained with corrosion inhibitors in the laboratory and in the field. G. E. Purdy and W. J. Ries. *Corrosion*, 1956, **12** (1), 17–22t.—The principal factors which influence internal corrosion in oil wells are reviewed and a lab corrosion test method discussed. Lab and field test data are presented for 3 W. Texas crude oil and brine systems and the corrosion inhibition obtained in these systems with 2 organic inhibitors. The correlation of lab and field data is discussed in relation to the many variables encountered, and it is concluded that the evaluation of the use of inhibitors in some cases may be difficult and may require considerable experience on the part of the corrosion engineer. W. G. R.

1096. An anomaly in pipeline corrosion diagnosis. L. P. Sudrabin. *Corrosion*, 1956, **12** (3), 99t.—In a Mid-Western refinery, complete penetration of a 400-ft long 4-inch hot water (170° F) line occurred within 2 years in several sand back-filled areas. The line currents measured did not account for the intense attack in the sand areas.

The author suggests that the porosity of the sand allowed alternate immersion and exposure to air on the hot pipe surface, resulting in the formation of magnetic iron oxide. This highly cathodic iron oxide scale, loosely attached to the underlying bare metal, supports an intense local action corrosion cell. W. G. R.

1097. Pipeline corrosion features NACE meeting. Anon. *Pipe Line News*, 1956, **28** (3), 42–54.—15 papers presented to the National Association of Corrosion Engineers at their annual conference in New York during March 1956 are reviewed. Topics include cathodic protection, chemical inhibitors, and corrosion principles. D. B. S.

1098. Cathodic protection teams up with water treatment to stop corrosion. M. J. Olive. *Oil Gas J.*, 16.4.56, **54** (50), 220.—Arkansas Fuel Oil Co make use of cathodic protection combined with water treatment to mitigate corrosion in its E. Texas gasoline plant. They use magnesium anodes, regulated current, and dimodic treatment of the water with pH controlled between 6·0 and 6·5. G. A. C.

ENGINES AND AUTOMOTIVE EQUIPMENT

1099. The Bradshaw Omega engine. Anon. *Oil Eng.*, 1956, **24** (273), 26.—The 4-stroke, air-cooled engine consists of a rotating, circumferentially-split annular cyl fitted with double-ended opposed pistons. Each set of 2 pistons, in shuttling back and forth, causes its hollow supporting shaft to oscillate. The reciprocating motion of the shafts is converted to rotation by connecting rods and 2-throw crankshaft. Merits and demerits of the design are very briefly discussed. A cutaway diagram and torque curves are given. C. B.

1100. Performance of the *Auris*. Anon. *Mot. Ship*, March–April–May 1956, **37** (432), 15.—An examination was made of the high pressure section of the turbine, it was in an unexpectedly clean condition; the stator blading showed slight deposits, these were a Na/V cpd and mostly on the second row of stator blading. The rotor was not examined as it had been dispatched for readjustments. The state of the bearings was satisfactory. In one section of one of the combustion chambers there was some slagging, otherwise the refractories were of sound condition. The port mixing chamber was cracked and corroded in parts, and is to be replaced. The mixing chamber's condition was reasonably good. The original burners were still in use. D. K.

1101. British free-piston engine development. Anon. *Mot. Ship*, March–April–May 1956, **37** (432), 16.—The 1000-s.h.p. free-piston engine test bed at Smith's Dock Co is described and details of its performance are given. Estimates and designs are being prepared for several proposed installations for merchant ships; whale catchers are particularly considered. D. K.

SAFETY PRECAUTIONS

1102. How to make tank-cleaning a safer job. J. E. McGuire. *Oil Gas J.*, 7.5.56, **54** (53), 157.—Basic safety principles are outlined, and ventilating with ejectors and aerating with water washing described. G. A. C.

1103. Surface application of foam to petrol fires. R. J. French, P. L. Hinkley, and J. F. Fry. *Chem. & Ind.*, 1956, 260–5.—Control and extinction of petrol fires by surface application of branch pipe quality foam were investigated. Concept of crit rate of surface application, *i.e.* min rate necessary to enable fire to be brought under control, allows useful comparisons to be made. Control time is defined as time at which radiation (as measured by radiometer) from fire falls to $\frac{1}{2}$ of its val at moment of foam application. Comparisons were obtained between 5 different foam cpds, 4 different sizes of fire, different rates of application of foam, and different expansion factors and crit shearing stresses. Main conclusions were: (1) within range studied (up to 50 ft²) there was no scale effect; (2) crit rate of application of foams produced from a soap and a wetting agent was approx twice that for protein foams; at rates well above the crit, however, control times were approx the same, but the non-protein types have poor post-extinction stability; (3) in normal range of shearing stresses expansion had no effect on control time, but this did not apply at higher stresses (>600 dynes cm^{-2}); (4) control time was approx $\propto$ crit shearing stress; (5) when using a good protein foam a rate of application of $\frac{1}{2}$ gal ft^{-2} min^{-1} (*ca* twice crit rate) should be adequate; (6) it is pointless to apply foam at <crit rate; until sufficient resources are available efforts would be better directed to prevention of spreading of fire. W. A. M.

MISCELLANEOUS

1104. The price of oil. R. A. R. Pattman. *Inst. Petrol. Rev.*, 1956, **10** (113), 119.—The price of a commodity sold determines the reward of the technical, organizational, and financial efforts put into the industry; forms the basis of economic planning, thus shaping future trends and influences public acceptance of the industry. A discussion follows the main paper. S. L. C.

1105. The economic impact of oil on the Arab Middle East. III. The effect of the companies (concluded). IV. Fuel and power. J. Murray. *Inst. Petrol. Rev.*, 1956, **10** (113), 137.—Pt III concludes by indicating the part played by security of employment, adequate and regular diet, education in the job, improved housing, hospitals and utilities, in stabilizing local labour; though the Bedouins' nomadic habits still give rise to a certain unavoidable turnover.

Pt IV gives figures for the electricity generated and oil fuel available, only a fraction of which is absorbed at source by local industry. The effect on the domestic consumption and economy of the oil revenues obtained is discussed. S. L. C.

1106. Refining industry in 1954. L. Zukrowski. *Nafta (Krakow)*, 1954, **10**, 275–6.—1954 marks the end of the 5th year of the 6-year plan. For this reason a brief review is considered useful. It shows that the plan provided an increase of 12% above 1953 and a 250% increase above 1950 (anticipating that a new tower installation will be on stream in the 4th quarter). These targets will probably be slightly exceeded. Compared with first 10 months of 1953 the figures for Jan.–Oct. 1954 are: stabilized gasoline (aviation) −2·9%; benzine (petrol) +1·3%; kerosine −6·3%; fuel oil +6·2%; machine oil +46·8%; engine oil +5·6%; cyl oil +5·7%; transformer oil +37·3%; axle oil +12·4%; solid grease +13·5%; regenerated lubricants +38·4%; wax −6·3%; asphalts +7·2%. Losses fell from 5·2 to 4·8%. Fall in kerosine and wax production is due to variation in crude, fall in stabilized gasoline due to short supply of wet gases. The vol of crude planned for the 5th year was actually refined by Aug. 15. Value of production rose since 1950 by 233%/worker. Savings were achieved by improvements, automation, and education of workers. Cost/metric ton of crude was Zl. 155·32 (*ca* £5 4*s.*), which is approx 7·5% less than in 1953. Building and construction programme has been adhered to so well that the 6-year plan will be completed 6 months earlier. Compared with 1949 the production at the end of 1955 will be 3 times as large. Lubricants will have gone up by 250% and motor fuels by 290%. 80–84% of crude has to be imported, as well as some products. The need for the discovery of new oilfield, probably in the N., is urgent. M. S.

1107. Statistics as an aid to specification. G. W. Sears. *J. Inst. Petrol.*, Apr. 1956, **42** (388), 105–18.—Paper discusses the value of statistics in the oil industry in the correlation of field performance with inspection test data. The utility of test methods in relation to their experimental errors and to manufacturing variability is discussed. It is maintained that many of the specifications, which have evolved gradually as the industry has expanded, place unnecessary restrictions on the refineries, and yet fail to ensure satisfactory field performance. It is suggested that in future satisfactory correlations between field performance and inspection data may form the basis for fully automatic plant and refinery control. 5 pages of discussion and 5 literature refs. C. B.

1108. Cost prices and analysis of technico-economical indexes. Anon. *Nafta (Krakow)*, 1954, **10**, 251–2.—These indexes must rise in order to lower the cost of production. Power and tools must be used more effectively through analysis of time and motion and better organization. Scientific invention and increased knowledge of oil reservoirs will help towards it. Loss of working time due to seizure of drilling bit or similar causes in 1954 promises to be double that for 1953 due to lack of technical supervision. Wrong wages structure is also to blame. Tools and materials deteriorate on storage in the open. There is no check on issues, but fortunately actual shortages are few. Whilst the scientific bodies are doing their best, managers have not yet grasped the way of turning technical improvements into economic advantages. M. S.

1109. Activity of Association of Petroleum Industry Engineers Balneotechnical Congress in Krynica. K. Konior. *Nafta (Krakow)*, 1954, **10**, 273–4.—Meeting took place on 3–4 Sept. 1954. 200 people took part. Papers were read on medical, industrial, geological, chemical, and bacteriological aspects of the matter. Pilot scale production of iodine and bromine is in progress, of magnesium in prospect. Matters of exploitation and supply of mineral waters were discussed. Further meetings are envisaged. M. S.

1110. First three dates in petroleum industry, 1853, 1854, 1858. J. Pilecki. *Nafta (Krakow)*, 1954, **10**, 267–9.—The first represents the year when the first paraffin lamp was lit by I. Lukasiewicz in the window of an apothecary in Lvov and later in a Lvov hospital operating theatre. First dist plants were also built in that year by him in Gorlice and Jaslo. First borehole was made in Krosno (previously crude oil came from a shallow dug-out) yielding 60–100 gal/day at the start and 2000 b.d. later. In 1858 first consignment of mineral oil dist was sold to Mr Wagenmann of Vienna and residual waxy material to an Austrian railway company. Other fractions were shown at an agricultural exhibition held that year at Jaslo. M. S.

1111. How Ethyl keeps run on upkeep costs—2. L. Resen. *Oil Gas J.*, 23.4.56, **54** (51), 103.—The valve repair shop of the Ethyl Corpn's Houston plant is described, where cleaning vats have been installed and a lapping bench constructed. A lapping device is described, together with a milling cutter and drill press. G. A. C.

BOOK REVIEWS

The Petroleum Acids and Bases. H. L. Lochte and E. R. Littmann. London: Constable & Co. Ltd., 1955. Pp. 368. 50*s*.

The non-hydrocarbon components of petroleum have for long been the subject of specialized study, in fact the earliest work on the identification of petroleum acids probably antedates serious attempts to isolate pure hydrocarbons from mineral oil. Those interested in this field will welcome this book, which represents the third monograph to appear (over twenty years after the second) on the subject of naphthenic acids, and also includes within its covers the first book-length study of the petroleum bases. Both these groups of compounds require, for their isolation from petroleum, the application of somewhat similar separation techniques, and much of the modern work on these two classes of minor petroleum constituents has been done at the University of Texas, where Dr Lochte occupies the chair of chemistry.

After a brief résumé of the previous work on naphthenic acids, the distribution of these in crude oil is considered and practical methods for their recovery from suitable distillates are described. Although the author is, of course, correct in stating that the bulk of naphthenic acids are recovered from gas oils and kerosines, his statement that acids removed from crude oil are "probably unrecoverable" is perhaps a little sweeping. Succeeding chapters deal with the purification of the acids, their analysis, and characterization by various physical properties. The author frequently refers to the well-known "Spitz and Hönig" method for the laboratory purification of naphthenic acids, but states (p. 46) that he has not been able to trace the original reference; this method was described by these authors over sixty years ago (M. Hönig and G. Spitz, *Z. angew. Chem.*, 1891, **4**, 585) in a paper dealing with the determination of unsaponifiable matter in fats, and is stated by them to be a modification of a procedure devised previously by Morawsky and Dembsky (*Dingl.*, 1885, 39).

The problem of the structure of naphthenic acids is dealt with at some length, particular attention being paid to the extensive investigations of von Braun in this field, the work of the University of Texas laboratory being, of course, also covered.

The final chapter in the first section of the book deals with the utilization of naphthenic acids, the U.S.A. production of which in 1954 was about 10,000 tons (a figure which the reviewer finds much easier to visualize than the 23·7 million pounds quoted by the author); presumably the production peak of over 17,000 tons recorded for 1951 was a result of military requirements for Napalm. Although production figures are given up to 1954, the statistics on consumption for various uses do not go beyond 1948. This chapter includes a selected but comprehensive list of references (including patents) divided among the principal uses.

Although, of course, naphthenic acids are the main concern of the first part of the book, the more comprehensive title of petroleum acids is justified by the inclusion of a chapter each on phenols and on fatty acids in petroleum; the account thus given of the position with regard to these two subdivisions of the field of petroleum acids is a very welcome inclusion.

The last quarter of the volume is devoted to the petroleum bases, and is really a separate monograph. Most of our knowledge of these materials arises from the activities carried out under the ægis of API Research Project 20. The nitrogen content of petroleum and methods for its determination are discussed, and it is pointed out that all the nitrogen compounds can be extracted with liquid sulphur dioxide, although less than half the nitrogen in the extract represents basic compounds (which are defined by the author as compounds titratable, in solution in acetic acid–benzene, with perchloric acid). The general pattern of the section on the petroleum bases follows that of the first part of the book, chapters being devoted to separation, early investigations (which would have been preferably placed immediately after the introduction, as was done with the corresponding chapter on the petroleum acids), work in the author's own laboratory, origin, and uses. In the present state of the art the last chapter, on uses, is unavoidably brief and largely speculative; undoubtedly the publication of the present book will ensure that in any future edition thereof this chapter will grow.

The book is well produced, the short chapters and generous leads making reading easy, whilst use of the bibliography is facilitated by placing the relevant references at the end of each chapter, although this unavoidably leads to some duplication, since certain references recur in two or more chapters. Among the very few errors noted in the bibliography mention may be made of ref. 9 on p. 16, which is incomplete and should be the same as ref. 15 on p. 38 or ref. 4 on p. 44.

Whilst primarily addressed to chemists interested in the field covered, the book will be of great help to anyone concerned with the industrial applications of these compounds.

V. B.

Oil Pipe Line Measurement and Storage Practices. Austin, Texas: Petroleum Extension Service, University of Texas. Pp. 134. $3.25.

This is Volume III in the series of four on "Oil Pipe Line Transportation Practices." Guidance in its preparation was given by the Committee on Personnel Training of the API Division of Transportation. The material compiled is based on approved API standards, but operating personnel of the pipeline companies have provided additional information.

The volume is intended principally for training purposes and as a work of reference for operators engaged in pipeline work. It is divided into five parts covering respectively: Tank Construction, Strapping Tanks, Tank Gauging, Tank Maintenance, and Quantity Measurement of Liquid Petroleum with Meters. The book concludes with an appendix on Cleaning Petroleum Storage Tanks.

The chapter on Tank Construction is divided into two sections—production tanks, also known as "flow tanks" or "lease tanks," used to receive crude oil from the well; and storage tanks, for storing and handling large quantities of oil. The types and specifications for these tanks are largely based on API standards and cover wooden, bolted, riveted, welded, floating roof, breather roof, balloon roof, spherical, and spheroidal tanks. Erection details are given.

Chapters II and III on Strapping and Gauging of storage tanks are closely related to the material contained in the latest edition of the API Code "Measuring, Sampling and Testing Crude Oil." The methods and apparatus used in "strapping" or calibrating storage tanks by the external circumference method are fully described in relation to all the various types of tanks dealt with in Chapter I; the chapter concludes with a section on the computation of tank contents based on the "strapping" report.

Chapter III deals with the gauging of tank contents by dipping (in the U.S.A. the term used is "innage") and ullaging (American term "outage"). Methods of sampling and of measuring tank temperatures and API gravities as well as B.S. & W. content are then described.

Chapter IV deals with painting of tanks, corrosion mitigation, tank cleaning, and general maintenance of tank storage.

With the increasing use of positive displacement meters for measuring liquid volumes it is good to see Chapter V

covering quantity measurement by this means. Various makes of these meters are described and their application discussed. Reference is made to ASME–API Code 1101 "Installation, Proving and Operation of Positive Displacement Meters in Liquid Hydrocarbon Service," which is highly regarded in the U.S.A. and has been largely used in the preparation of Chapter V.

Appendix A deals with the cleaning of crude oil and unfinished-products tanks, warning against the hazards in such processes and the steps to be taken to ensure safety; and finally, the special precautions which should be taken when entering and cleaning tanks which have held leaded gasoline or sour crude.

This small volume should prove of considerable value to those responsible for training personnel or actually engaged in the storage, sampling, and measurement of crude oil in the fields. It is excellently illustrated with 179 line drawings and pictorial illustrations. H. H.

Distillation in Practice. Ed. Charles H. Nielsen. New York: Reinhold Publishing Corpn; London: Chapman and Hall, 1956. Pp. 133. 24*s*.

This is a most readable book of interest to young chemical engineers in the petroleum industry. The book presents a collection of papers by a group of experienced chemical engineers to young engineers at a symposium jointly sponsored by the Philadelphia–Wilmington Section of the American Institute of Chemical Engineers and the University of Pennsylvania.

Although the amount of technical information on plant and column design is very limited, the value of the book is in introducing the young inexperienced chemical engineer to some of the practical difficulties of starting-up, of operation, and of instrumentation of distillation equipment. The importance of these more practical aspects of distillation are emphasized by humorous sketches and the personal experiences of some of the authors. S. R. M. E.

ADDITIONS TO THE LIBRARY

English–German Oil Dictionary. Compiled by F. Persch. Berlin-Konradshöhe: Rudolf Schmidt, 1955. Pp. 416. DM. 34.

This publication gives the German equivalent of upwards of 10,000 English (or, more accurately, American) terms in the field of oil exploration and geology, geophysics, drilling and petroleum production, storage, and transportation. Analytical, refining, and chemical aspects of the petroleum industry are largely excluded. In addition to the translation of numerous individual terms there are also many entries against short phrases (*e.g.* "round-tripping the drill pipe," "legibility of a map"). Although the book will undoubtedly be useful in certain circumstances, its high price (*ca* £3) for what is virtually a pocket dictionary will tend to diminish its appeal in the U.K.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1112. Habitat of some oil. G. M. Knebel and G. Rodriguez-Eraso. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 547–61.—This paper affords a statistical study of the habitat of most of the world's ultimate oil discovered to date outside the U.S.S.R. and its affiliated countries. "The Habitat of Oil in the Sedimentary Basin" was the central theme at the Annual Meeting of the American Association of Petroleum Geologists held in New York in March 1955, at which meeting most of the world's producing basins were covered.

Detailed statistics have been prepared and studied for 236 or all of the major oilfields of the free world. They represent 217 billion brl, which is 82·5% of the free world's ultimate reserves discovered to date. The study shows the bulk of this oil occurs: (1) on the stable side of basins; (2) in anticlines; (3) in sandstone and carbonate reservoirs; (4) from formations of Mesozoic age or younger; and (5) from a depth range of 2000 ft.

Most of the free world's ultimate oil is 30° API gravity or lighter, with mixed-asphaltic-base oils predominating. The discovery of the free world's major oilfields has been cyclic, with 10-year intervals beginning in 1917. E. N. T.

N

1113. Recent trends in oil geology. Pt 2. Theories of the origin of petroleum. J. C. M. Taylor. *Petroleum, Lond.*, 1956, **19** (4), 125.—The various theories of the origin of oil are discussed in their historical contexts and attention is drawn to 2 important facts: (1) all crude oils have certain features in common irrespective of time and place, and (2) detailed differences occur between the fluids of different fields, even of the same area. 3 mechanisms of conversion of organic material to petroleum are considered: heat and pressure, radio-activity, and bacterial action. The latter is the most widely accepted mechanism. In recent years it has been shown by detailed chemical work that recent sediments can contain appreciable quantities of liq hydrocarbons. This proves that hydrocarbons are formed at a geologically early age in the history of sediments. 4 refs. C. A. F.

1114. New method for mapping old shorelines. W. F. Tanner. *World Oil*, 1956, **142** (5), 123.—The use of plots of cross-bedding directions in palæogeographical studies is outlined, and 5 common patterns of cross-bedding are described in relation to channel deposits and littoral currents. Examples from Alabama, Georgia, and Oklahoma are included. 4 refs. C. A. F.

1115. Geochemistry of subterranean waters : application to petroliferous beds. H. Schoeller. *Rev. Inst. franç. Pétrole*, 1955, **10** (6), 507–52.—The composition of natural gas and petroleum is discussed, and then the environment and some of the possible reactions involved in the formation of petroleum. Some of the possible changes in petroleum in the rocks are indicated, and it is noted that the formation and transformation of petroleum and natural gas may be associated with changes in the composition of waters in the sediments.

Data are given on the gases dissolved in oilfield waters. Naphthenic acids have been observed. There is extensive discussion of the chloride, fluoride, bromide, and iodide content in the waters, and of the amounts and possible sources of these components. Certain ratios are examined, and comparisons are made with the ratios in which these elements occur in rocks. Finally, data are given on the amounts of these elements in oilfield waters from various parts of the world, and also in a series of mineral waters.

G. D. H.

1116. Paleontology, basis of practical geochronology. J. A. Jeletzky. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 679–706.—The neglect of the geochronological value of palæontology and the assumption that many physical-stratigraphical methods (lithological similarity of rocks, their petrofabrics, interrelation of strata in sections, occurrence of bentonitic beds or lava flows, electric resistivity of rocks and their thermoluminescence) are of considerable geochronological importance, in addition to being stratigraphically valuable, is widespread in modern literature.

This paper is an attempt to analyse the reasons for the neglect of the geochronological value of palæontology, as well as those leading to the overestimation of the geochronological value of other methods, and it suggests a way to remedy the existing situation. This situation is attributed to : (1) overspecialization of geologists and palæontologists ; (2) the simplicity and easy comprehensibility of various modern physical-stratigraphical methods compared with the inherently complex and mostly slow methods of palæontological chronology ; and (3) the currently widespread confusion of stratigraphy and geochronology. E. N. T.

1117. Gyratory sieving and straining applied to geological research. R. H. Cummings. *Petroleum, Lond.*, 1956, **19** (4), 130–1.—Sieving is employed in geological research for grain size analysis, separation of mineral fragments, micro-faunal analysis, and concn of rare minerals. The Russell unit has been tested in each of these applications under dry sieving conditions and has proved successful. Wet sieving is also possible. The application of gyratory vibration yields greater outputs and greater freedom from mesh binding. J. B. S.

1118. Don't write off the Atlantic coastal plain. H. G. Richards. *Oil Gas J.*, 30.4.56, **54** (52), 182.—Oil possibilities in the Atlantic coastal plain of the U.S.A. are reviewed and the geology of the belt outlined. In New Jersey beds thicken to the SE. and the Cretaceous offers possibilities, and offshore drilling should not be discounted. Conditions in Delaware are similar to those in New Jersey, and several unsuccessful tests have been drilled. In Maryland there is the Salisbury embayment, where Trias occurs beneath the Cretaceous ; unsuccessful wells have also been drilled here. A similar Trias basin or graben is believed to occur in N. Carolina : no commercial production has been found in test wells. The geology of S. Carolina is similar to that of N. Carolina, and a few wells have been drilled, mainly in the S. flank of the Great Carolina Ridge. In Georgia *ca* 80 tests have been made, and although commercial oil has not been found, interest is maintained by the recent discovery of oil in Alabama. 5 refs. C. A. F.

1119. Correlation of Paleocene and Eocene formations and Cretaceous-Paleocene boundary in New Jersey. H. W. Miller, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 722–36.—The author shows that in New Jersey the Hornerstown formation can be correlated with the Midway stage (Palæocene) of the Gulf Coast. The Vincentown formation is correlated with the Aquia formation (lower Eocene) of Maryland, and the Manasquan formation is correlated with the Claiborne stage (middle Eocene) of Alabama. The presence of a " middle greensand " unit between the Navesink (Cretaceous) and Hornerstown formation is recognized, and it is suggested that this is a southwestward extension of the Red Bank formation (Cretaceous). E. N. T.

1120. Deep test finally completed. Anon. *Oil Gas J.*, 14.5.56, **54** (54), 101.—I-L. Humble-L.L. & E., Louisiana, has been completed as the world's deepest producer. On test the well flowed 206 b.d. from 2 sections separated by shale at *ca* 21,400 ft. The last test showed 0·3% fresh water and mud, and corrected oil gravity is 43°. Total depth is 22,570 ft.

A nearby well, 1 State lease 2345, abandoned in 1954, is to be deepened to a projected depth of 22,500 ft. C. A. F.

1121. Genesis of salt domes of Gulf Coastal Plain. M. T. Halbouty and G. C. Hardin, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 737–40.—Salt domes are the most outstanding geologic features of the U.S. Gulf Coastal Plain, and their genesis is one of the most interesting and controversial subjects studied by geologists. Salt domes constitute the most complicated of producing structures, and the key to the interpretation of their associated structural and sedimentational complexes lies in the genesis of the domes. The writers believe that a clearer understanding of the genesis of the domes is of utmost importance in the future exploration of these structures.

The mode of deposition of the mother salt bed from which the salt domes of the Gulf Coastal Plain arose is discussed. Deposition of the salt in a restricted basin during Permian time is postulated, the deposition taking place under the conditions of Branson's " modified bar " theory. The Castile sea of the Delaware Basin area of W. Texas is thought to have been the first of the " barred basins " necessary under the Branson theory.

The mechanics of the growth of the salt plugs of the Gulf Coastal Plain is discussed. The motive force for the intrusion of the salt plugs is attributed to the static weight of the overlying sediments, resulting in a buoyancy effect caused by the difference in density between the salt and the sediments.

E. N. T.

1122. Deep south ready for deep pay off. N. S. Morrisey. *Oil Gas J.*, 30.4.56, **54** (52), 156.—Recent discoveries of Lower Cretaceous production have emphasized the importance of this formation as a potential source of oil in Mississippi, Alabama, and N. Florida. Until recently the main targets were Wilcox, Eutaw, and Tuscaloosa, and there has been relatively little drilling into the Lower Cretaceous. Recently discovered fields in this formation are Bolton (1954), an anticline on the downthrown side of a fault which produces from the Paluxy ; Ansley, producing from the Washita–Fredericksburg ; Citronelle, producing from lenticular sands in the Rodessa ; and Soso (1953), which is the most important, an anticline producing from several pay zones in the Sligo.

Exploration is mainly by seismic work, but facies changes are as important as structure in determining the position of fields, and the best possibilities for production are where continental and marine facies interfinger or where marine sands were deposited.

The geology of the area is outlined, and an electric log cross-section of Soso and a location map of the recent discoveries are given. 8 refs. C. A. F.

1123. Mississippi structure shows promise of vast reserves. W. Hughes. *World Oil*, 1956, **142** (5), 115.—The discovery of the Ansley field, Hancock County, Mississippi, has increased the possibility of discovering large reserves in the state. The well, Cuevas 1, on test flowed 264 b.d. of 41·8° oil and 2·5 m.c.f. gas from Lower Cretaceous Washita–Fredericksburg ;

the test followed a number of dry holes in the area. There are possibilities that there may be oil in the Miocene Heterostegina and that the deeper Citronelle pay may be present. Structure maps of Mississippi and a cross-section are included. C. A. F.

1124. Appalachian test goes to basement. P. H. Price. *Oil Gas J.*, 2.4.56, **54** (48), 180.—The history and stratigraphy of a recent well drilled on the Volcano Burning Springs anticline in W. Virginia are outlined. The well was the first to be drilled entirely through the Ordovician and Cambrian of the Appalachian basin. It was bottomed at 13,331 ft in pre-Cambrian gneiss and abandoned as dry, although there were favourable indications throughout the sequence, particularly in Cambro-Ordovician, where a 300-ft section had gas shows and vugular porosity.

Further testing of these old rocks in W. Virginia is indicated. C. A. F.

1125. Sedimentation . . . key to Appalachian production. E. H. Linn. *Oil Gas J.*, 30.4.56, **54** (52), 165.—Future oil possibilities of the Appalachian basin are described, and it is shown how surveys in the past have overlooked the fact that accumulations in the area are mainly stratigraphic. The logical approach is to search for deep stratigraphic traps in the Cambro-Ordovician, and this requires a study of the palæogeography and depositional history of the basin during those periods. Isopach maps and cross-sections illustrate some of these features. Some of the problems of leasing in the area are outlined, together with the probable drilling depths and economics of deep drilling. C. A. F.

1126. Sandstones and channels in Upper Pennsylvanian and Lower Permian in Kansas. M. R. Mudge. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 654–78.—In E. Kansas, almost every shale formation of the Upper Pennsylvanian and Lower Permian rocks contains a channel, which is regarded as the basal unit of a cyclothem. These channels range from small cut-and-fill structures within the formational boundaries to large channels that were eroded into the underlying formations. The channels that have been recently discovered originated in the Willard, Pierson Point, Langdon, Pony Creek, West Branch, and Hamlin shales, and in the Caneyville limestone.

A study of these channels may clarify some of the confusion in the subsurface correlation and surface identification of these units.

The present study was restricted to the upper 150 ft of Pennsylvanian rocks and the lower 100 ft of Permian rocks (Willard shale up to the base of the Foraker limestone).

It is shown that most of the channels are filled with non-marine sediments, though a few are partly filled with marine sediments. The sediments were probably derived from the N. and NW. The channels are deepest and most extensive in the youngest Pennsylvanian sedimentary rocks, but no channel can be selected as the unconformity between the Pennsylvanian and Permian. E. N. T.

1127. Stratigraphy of lake deposits in Central and Northern Minnesota. F. M. Swain. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 600–53.—Samples of the bottom sediments of several lakes in Minnesota have been studied for the purpose of determining the variation in type of sediment, development of facies, and principal kinds of liq substance. The lakes studied are Echo and Gideons bays, Lake Minnetonka, Hennepin County; Prior Lake, Scott County; Lake Johanna, Ramsey County; Cedar Lake, Wright County; and Burntside Lake, St Louis County.

The constitution, properties, and facies of the lake sediments are discussed. Internal standing waves are believed to have been important in the distribution of the copropelic sediment.

Lipoid extracts of some of the sediments were obtained with a benzine–methanol–acetone mixture and were separated by adsorption chromatography. Fractions representing saturated and aromatic hydrocarbons were found in all the extracts. Partial characterizations were made by means of absorption spectra in the visible, i.r., and u.v. ranges. In Burntside, the extracts were mainly hydrocarbons plus some asphaltenes, but with very little polar organic substance. The other lakes yielded greater proportions of these polar substances, probably as a result of their heavy crops of protein-rich blue-green algæ and pondweeds, which are mainly lacking in oligotrophic Burntside Lake. The largest quantity of hydrocarbons (0·36% of sample) was obtained from the copropel of Cedar Lake, in which the saturated and aromatic fractions were about equally represented. E. N. T.

1128. Kansas' structural provinces offer varied types of trap. D. F. Merriam and E. D. Goebel. *Oil Gas J.*, 30.4.56, **54** (52), 141.—Oilfield development and future possibilities of oil in Kansas are described; with increasing activity the total number of discoveries is increasing, and future development requires the application of new techniques and more detailed exploration of the partly developed areas. The search for stratigraphic traps is now the main interest.

The state can be divided into 9 structural provinces, and the oil possibilities of each of these are considered. In the Forest City basin future prospects include stratigraphic traps in the west, where the Lower Palæozoic wedges out on the Nemaha ridge. In the Cherokee basin the Arbuckle is encouraging, and on the ridge there may be discoveries in closed structures and stratigraphic traps in the W. part of the state. Structural and stratigraphic traps may also occur on the flanks of the Salina basin, the centre of which is almost unexplored. In the Sedgwick basin there are possibilities of various types of trap as well as secondary recovery from shallow zones. The Cambridge Arch and the Central Kansas uplift have good possibilities, and on the Pratt anticline there are possibilities in the Lower Palæozoic. The Hugoton embayment has not yet been adequately tested, and there are now important oil possibilities with the recent discovery of oil in the Arbuckle.

The stratigraphy of Kansas is also described, and specimen logs are included. 2 charts show fields in Kansas with a production of over 1 million brl in 1954, and Kansas fields having a cumulative production exceeding 10 million brl. 16 refs. C. A. F.

1129. Cherokee trend stretches out 30 miles. N. S. Morrisey. *Oil Gas J.*, 7.5.56, **54** (53), 176.—The geology and field development along the Cherokee trend in Oklahoma are described briefly. The productive trend is 30 miles long and one mile wide, and production is determined by stratigraphic conditions. Traps may be along old shore lines or the trend may be a river channel.

The pay is basal Pennsylvanian Cherokee sand at *ca* 4900 ft. Reservoir energy is normally solution gas with recoverable reserves *ca* 125–150 brl/acre-ft. Wells are fractured prior to completion, and average yield is 25–50 b.d. Tables give typical reservoir characteristics of the pay and drilling data along the trend. C. A. F.

1130. New exploratory era on Northern shelf. J. C. McCaslin. *Oil Gas J.*, 16.4.56, **54** (50), 286.—Recent discoveries in the Ordovician on the flanks of the Pratt anticline in SW. Kansas and NE. Oklahoma have emphasized the regional importance of shelf rocks in future development of the area. The most recent find, 1 Parks in Comanche County, found dist and gas in the Simpson at *ca* 5650 ft.

5 areas in widely separated parts of the Anadarko basin have found production in Ordovician and Cambro-Ordovician rocks: Grigsby and Beals fields in Kansas, Yellowstone and NW. Oakdale in Oklahoma, and Laketon-Deep in Texas. C. A. F.

1131. Stratigraphy of Upper Cretaceous and Tertiary rocks of Raton basin, Colorado and New Mexico. R. B. Johnson and G. H. Wood, Jr. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 707–21.—The Raton basin is a late Upper Cretaceous and

Tertiary structural and sedimentary basin that lies in SE. Colorado and NE. New Mexico in the westernmost part of the Great Plains province.

A thick sequence of late Upper Cretaceous and Tertiary sedimentary rocks is preserved in the Raton basin. These strata include the Pierre shale, Trinidad sandstone, and Vermejo formation of Late Cretaceous age; the Raton formation of Late Cretaceous and Palæocene age: the Poison Canyon formation of Palæocene age; the Cuchara and Huerfano formations of Eocene age; and 2 newly defined formations, one probably Oligocene and the other probably Miocene in age. The rocks record some of the stratigraphic and structural events of the Laramide revolution.

E. N. T.

1132. The Northern Raton basin . . . an exploratory frontier. J. A. Lewis. *Oil Gas J.*, 14.5.56, **54** (54), 128.—The N. part of the Raton basin in S. Colorado and NE. Mexico is one of the few major unproductive basins in the Rocky Mountain area, although it has every indication of an important oil and gas potential: a thick section of marine beds, surface anticlines, excellent possibilities of stratigraphic traps, and oil and gas shows.

Structural conditions in the basin and its stratigraphy and depositional history are described, together with subsurface and surface shows which have been found. Beds range from Pennsylvanian through Tertiary; within the Cretaceous, Jurassic, Permian, and Pennsylvanian there is a total of 500–1000 ft of objective reservoir sands. Prospective traps occur in high-relief structures which were developed during at least 2 periods of folding. Many structures should be located by seismic and surface mapping. Stratigraphic traps appear promising in several formations. C. A. F.

1133. Marine Jurassic exposed in Bighorn basin, Pryor Mountains, and Northern Bighorn Mountains, Wyoming and Montana. R. W. Imlay. *Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (4), 562–99.—The lengthy study of the exposed marine Jurassic of N.-Central Wyoming and S.-Central Montana has resulted in the accumulation of considerable stratigraphic and palæontologic data which have permitted the author to present detailed correlations between Montana and areas to the S. A detailed description and analysis of the data and of the interpretations bearing on the compilation of structural maps are therefore presented.

For the purpose of this paper, the marine Jurassic rocks in this region are divided into 3 major units, of which those in Wyoming are the approx lithic and time equivalents of those in Montana. The lowest is of Middle Jurassic age, the middle of early Callovian age, and the upper of Oxfordian age. These units, according to the writer's interpretation, represent 3 distinct marine invasions that are separated by intervals of erosion during late Bathonian and late Callovian time. Evidence for erosion is particularly well shown in exposures along the E. side of the Bighorn basin. An upwarp in the vicinity of Tensleep influenced sedimentation during Callovian and Oxfordian time, and apparently rose above the sea as a low island near the beginning of Callovian time. E. N. T.

1134. Where production comes from in four important Rocky Mountain basins. J. C. McCaslin. *Oil Gas J.*, 30.4.56, **54** (52), 242.—Representative electric logs from the San Juan, Williston, Big Horn, and Denver–Julesburg basins are given, together with photographs of typical cores of producing rocks. Geological conditions, pay zones, and significant fields in each basin are also briefly described. C. A. F.

1135. Sweetgrass Arch . . . forgotten corner of the Rockies. E. A. Gribi. *Oil Gas J.*, 30.4.56, **54** (52), 174.—The Sweetgrass Arch is becoming recognized as an important oil-bearing province with relatively shallow reservoirs. Conditions are favourable: there are 5000–7000 ft of Mesozoic and Palæozoic sediments with a shelf facies flanking the Cordilleran geosyncline. The geology and history of development of the area are outlined and the fields mentioned briefly. It is shown that development techniques in this area have until recently lagged behind those elsewhere. The most active exploratory year was 1955, with geophysical work and drilling in the Disturbed Belt, which is a S. continuation of the zone that contains Turner Valley and other fields in Alberta.

A map showing the fields on the Arch, cross-section, and a type log are included. One ref. C. A. F.

1136. Alberta's multiple pays are top wildcat targets. J. C. Sproule. *Oil Gas J.*, 14.5.56, **54** (54), 213.—The geology and oil prospects of the Sundre–Westward Ho–Harmattan area are described. This is one of the most promising areas of W. Canada. Beds range from Cambrian to Upper Cretaceous, with a non-marine Tertiary section, and the area is on the E. flank of the Alberta syncline. The best prospect is the Upper Cretaceous Cardium sand, which pinches out eastwards, and other zones in the Cretaceous and Mississippian also have possible stratigraphic prospects. A number of other prospects is also listed.

A structure map and cross-section of the area are included. C. A. F.

1137. Brazil test hits. Anon. *Oil Gas J.*, 7.5.56, **54** (53), 103.—A wildcat near Balsas in Maranhao, Brazil, found oil and gas shows at *ca* 4200 ft as the first evidence of oil in the Maranhao basin. The find is *ca* 1150 miles NE. of the producing fields in Bahia and is situated on an anticline. 3 further wells are to be drilled in the basin. C. A. F.

1138. Philippine wildcat finds show. Anon. *Oil Gas J.*, 28.5.56, **54** (56), 102.—Oil is reported in the first deep test drilled in the Philippines. The well is in the Cagayan Valley of N. Luzon, and there were indications at 9026 ft. Projected depth is 12,000 ft and coring is planned. Leasing interests are briefly noted. C. A. F.

1139. Deepest Wapet test dry. Anon. *Oil Gas J.*, 23.4.56, **54** (51), 91.—Cape Range 2 in W. Australia has been abandoned as dry at a total depth of 15,188 ft; minor gas shows were found in the Jurassic at *ca* 10,000 ft, and these tested a minimum of less than 2000 cu. ft/hr. A wildcat is being drilled at Frazer River on the Dampier peninsula of NW. Australia *ca* 700 miles NE. of the Exmouth Gulf area, where the Rough Range discovery was drilled. Structure drilling is to be carried out mainly in the Gulf area to supplement geological and seismic work. Other activities in W. Australia are also briefly noted. C. A. F.

1140. Examination of the oil possibilities of the Limagne. J. L. Rumeau. *Rev. Inst. franç. Pétrole*, 1955, **10** (11), 1319–34.—The Limagne basin has been explored by wells drilled at various dates from 1883 to 1932. No commercial oil accumulations were found, but almost all the wells had hydrocarbon shows. Pre-Carboniferous metamorphics occur, some partly metamorphosed Lower Carboniferous, and Permian beds. The only Eocene known is in a tiny lacustrine basin 20 km W. of Gannat. It has black bituminous shales. The lower part of the Sannoisian is detrital, and the upper part calcareous or marly. The Stampian provides most of the Limagne sediments, being over 1200 m thick, and comprises detrital rocks, sandy limestone, gypsum, and fine-grained limestones. There are pyrobituminous shales. Thin bituminous sandstones have been found. Thick marls have been met in the middle Stampian, and calcareous deposits dominate the upper Stampian. Reefs and marls are found in the Aquitanian.

Bituminous limestones (Stampian) are worked at Pont-du-Chateau. Lower Stampian arkoses carry bitumen at Escorchade, and this may have migrated across a fault.

All the hydrocarbon shows are of Oligocene age. Cover rocks are present, and the arkoses are the principal reservoirs. Faulting occurs. Most of the wells have been in areas affected by thermal waters. Geophysical work in N. Limagne has shown the basin to be deeper than supposed, and this area may merit further investigation. G. D. H.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

1141. What causes low radiation intensities over oilfields? H. Lundberg. *Oil Gas J.*, 30.4.56, **54** (52), 192.—A hypothesis to explain the low radiation intensities over known oilfields is presented. It is suggested that they are related to the migration of waters in deep formations and that small amounts of sulphates are precipitated at the surface. These are believed to be distributed according to a pattern influenced by the directions of upward flow of water, which is said to be deflected away from oil accumulations.

The radiation recording instruments must have a high counting efficiency, and in an airborne survey the recordings must be made at optimum altitude and integrating time.

C. A. F.

DRILLING

1142. Air and gas drilling. C. L. Moore and V. A. Lafave. *J. Petrol. Tech.*, 1956, **8** (2), 15–16.—Since 1951 the El Paso Natural Gas Co has completed 400 wells in the San Juan basin using gas as the circulating fluid, and 800–1000 wells have been drilled by this means in this area. The average depth is *ca* 5000 ft, while the Cretaceous gas formation has very low porosity, low permeability, and a pressure of 1250 p.s.i. The 800 ft of interbedded sands, shales, and coals from which gas is obtained was completely blocked by drilling mud; while cable tools might take 5–8 weeks to drill this section. Air was first used for the drilling in 1953. Gas drilling involves fire risks, and there has been an explosion while drilling with air. If water enters the hole when drilling with air, the dust and mud in certain proportions cause balling-up and the risk of stuck drill-pipe. Small amounts of water are more dangerous than large amounts. The water may be exhausted by circulation, but if this fails casing is needed. Alternatively the dust may be "water-proofed."

Air drilling is more rapid than mud drilling. 2·5–3·5 M.M.c.f./day at 200–250 p.s.i.g. seems adequate for drilling to 7000 ft. Air drilling equipment must be flexible, easily moved, and designed for the job. Saving in drilling time may more than compensate for repairs or replacements.

G. D. H.

1143. Indexing sub reveals effect of bit hydraulics in hard rock drilling. R. J. Bromell. *Oil Gas J.*, 7.5.56, **54** (53), 130.—The conclusions of an API Committee on jet-bit drilling are that bit h.p. is of little consequence at drilling rates below 14 ft/hr, provided there is adequate cleaning; and that drilling rates are not materially increased with 110 or less bit h.p. unless the drilling rate with conventional bits is at least 26 ft/hr. It was also concluded that at drilling rates of 25 ft/hr or less, power to increase speed is more important for penetration than increase of bit h.p. These results apply only to an 8¾-inch hole with 60,000–70,000 lb wt and 50–80 rev/min, and it is suggested that more work is required to determine the effective upper ranges of h.p.

In assessing the value of jet-bit drilling, several bits were run using an indexing sub with which the flow could be alternated from jet to conventional courses. C. A. F.

1144. How to increase your drilling rates. W. R. Wardroup and G. E. Cannon. *Oil Gas J.*, 30.4.56, **54** (52), 204.—Average footage/rig year in the U.S.A. has increased in recent years, but this has not resulted in reduced well or footage costs. Well costs are increasing, and these could be reduced by more careful consideration of factors affecting drilling rate. 7 different ways of increasing drilling rate are discussed; these are: (1) use of bigger drill collars and increased weight on bit; (2) selective use of specialized bits; (3) use of low mud density where possible; (4) circulation of air, gas, or aerated mud; (5) use of surfactants in drilling water; (6) use of larger mud pumps, increasing bit power, and nozzle velocity; and (7) the installation of feed control. Charts and tables illustrating the saving of drilling time under some of these conditions are included. 10 refs. C. A. F.

1145. Developing and testing of jet pump pellet impact drill bits. J. E. Eckel, F. H. Deily, and L. W. Ledgerwood. *J. Petrol. Tech.*, 1956, **8** (1), AIMME Tech. Paper No. 4202, 1–10.—Extensive lab work and some shallow field tests have been done on the use of high-velocity pellets, circulated in the bottom of the hole, for drilling. A primary nozzle sends high-velocity fluid into the secondary nozzle, aspirating annulus fluids and pellets, and accelerating the latter to pound the rock. Consideration has been given to many factors such as primary nozzle dia, secondary nozzle length and dia, distance off bottom, and numbers of pellets and sizes.

Water was found to be better than air or mud. *Ca* 80% of the pellet energy was utilized in crushing the rock, but the pellets transmit only *ca* 3% of the primary nozzle power to the formation. Slow rotation was needed, because of the presence of feet to give the appropriate off-bottom spacing. A 9-inch bit drilled Oklahoma marble at 7·5 ft/hr, Virginia limestone at 4 ft/hr, and quartzite at 0·5 ft/hr. The pellets were rough 1½-inch ball-bearings, and in the quartzite 140 lb of balls lost 2·5 lb in 3·5 hr. Fluid power at the bit was 168–182 h.p. G. D. H.

1146. Lost circulation information with a new tool for detecting zones of loss. T. Bardeen and A. J. Teplitz. *J. Petrol. Tech.*, 1956, **8** (2), AIMME Tech. Paper No. 4026, 36–41.—The device consists of a thin-walled cyl with a window in the middle, a small opening at the bottom, and large vents at the top. It is run on logging cable, and when there is fluid motion in a downward direction pressure builds up inside the cyl and fluid tends to flow out through the window, which is partly obstructed by a flexible membrane. This membrane, a strip, has a central electrode which lies between 2 electrodes set on either side on a rigid insulated frame. Movement of the membrane electrode results from fluid flow and disturbs the previously balanced electrical circuits. Thus velocities of flow of as little as 5 ft/minute can be detected. Lost circulation additives do not interfere with the operation of the device, and by suitable placing the point of loss can be pin-pointed and so dealt with more effectively.

In a number of surveys it has been shown that the zone of loss is very narrow (under 1 ft), and it appears that the fissures are more or less horizontal rather than vertical. Pressure parting may cause these breaks. The device may possibly be used in hydraulic fracturing work and for finding points of water entry in producing wells. G. D. H.

1147. An accelerated squeeze-cementing technique. G. K. Dumbauld, D. Perry, G. W. Binkley, and F. A. Brooks. *J. Petrol. Tech.*, 1956, **8** (1), AIMME Tech. Paper No. 4201, 25–9.—In squeeze cementing, and especially that connected with permanent-type well completions, there would be appreciable savings in time and money if the cement set more rapidly to permit earlier testing. Lab tests on filter cakes from 3 low-water-loss cements have shown that calcium chloride soln give more rapid development of strength and impermeability of the cement cake. Furthermore, an oil emulsion cement was more susceptible to acceleration than modified cements with high proportions of bentonite. The accelerator is applied after excess cement has been reversed from the well.

The technique has been successfully applied in the field. Tests after 12–14 hr with accelerated set were substantially better than was normally obtained after 24 hr with no accelerator. For the oil-emulsion cement there were indications of satisfactory strength after a few hr. G. D. H.

1148. Application of directed drilling in Yugoslav practice. N. Cizmic. *Nafta* (*Yugoslavia*), 1956, **7** (4), 103–7.—Several cases of directed side drillings applied in the oilfields at Mramor Brdo and Klostar are described and the desired aims explained. The techniques used in these cases are quoted and the achieved results analysed. (Author's abstract.)

1149. 70 wells will drill from this island. D. H. Stormont. *Oil Gas J.*, 14.5.56, **54** (54), 140.—A drilling island built offshore from Seal Beach, California, is briefly described. The structure, in 45 ft of water, has a shell of concrete which is earth-filled and was designed for the drilling of 70 slant wells. A number of these have been completed. C. A. F.

PRODUCTION

1150. Permanent-type dual completions find favour. Pt 2. G. H. Tausch and J. W. Kenneday. *Oil Gas J.*, 2.4.56, **54** (48), 117.—A new use for retrievable production tubes with parallel tubing is described. These are used to permit perforation of both zones in the presence of a clean fluid and to allow workover of either the top or bottom zone without a rig. Diagrams illustrate tubing arrangements. C. A. F.

1151. Experimental water flooding recoveries above and below the bubble point. D. M. Bass and P. B. Crawford. *J. Petrol. Tech.*, 1956, **8** (1), 45–7.—Experiments have been made on unconsolidated sand packs, using 3 synthetic reservoir crudes to find the effects of fluid characteristics, gas saturation, water saturation, and water injection rate on oil recovery by water flooding. The initial production was by solution-gas drive, and this was followed by water flooding at various pressures. The total oil recovery was found to vary with the pressure at which water flooding was carried out. At a certain pressure and gas saturation for a given crude there was max oil recovery. For a crude with a bubble point of 860 p.s.i., flooding at 500 p.s.i. gave 9% more oil than flooding at 1000 p.s.i. For another crude (bubble point 1885 p.s.i.) max oil recovery was the same for 2 flooding rates, but was attained at 1600 p.s.i. for 87 cc/hr and 850 p.s.i. for 20 cc/hr. G. D. H.

1152. Modifications to decline curve analysis. H. N. Mead. *J. Petrol. Tech.*, 1956, **8** (1), AIMME Tech. Paper No. 4200, 11–16.—The basic assumption is made that the rate of change of the reciprocal of the decline, for succeeding time intervals, is constant.

The change is zero for exponential declines, and for hyperbolic declines it ranges between 0 and 1. If the cumulative recovery is

$$C = P_1 + P_2 + P_3 + \ldots P_n, \text{ and } \frac{P_n}{P_n - P_n + 1} = a_n,$$

while $a_{n+1} = a_n + b$, then

$$C = \frac{a_0 P_1 - a_n P_n + 1}{1 - b}, P_1, P_2, \text{ etc.},$$

being the outputs for constant time intervals.

Ranges of characteristic values for b are given for different drives, and for various forms of pressure maintenance. Examples of the use of the above relationship are discussed in detail, both for natural depletion and pressure maintenance. It is assumed that the reservoirs are produced at max rates after decline sets in. G. D. H.

1153. Simultaneous flow of liquid and gas through horizontal pipe. A. F. Bertuzzi, M. R. Tek, and F. H. Poettmann. *J. Petrol. Tech.*, 1956, **8** (1), AIMME Tech. Paper No. 4203, 17–24.—Long-gathering lines with more than one phase flowing have called for a review of the factors to be considered in design. Some 267 published sets of experimental data have been randomly selected and analysed, with the plotting of an energy dissipation function against a Reynolds No. function for the system for 5 different ranges of gas–liq mass ratios (for gas–liq vol ratios over 50,000 cu. ft/brl gas flow equations can be used). A procedure was developed for calculating pressure gradients, and on comparison with the experimental values there was a standard deviation of 20·8% and a bias of +0·82%.

A chart is given for estimating the pressure drop for horizontal multi-phase fluid flow in pipes, and the detailed use of this chart is explained. The method is said to be relatively independent of flow patterns, and to give closer predictions than other available methods. G. D. H.

1154. Neutron log correction charts for borehole conditions and bed thickness. J. T. Dewan. *J. Petrol. Tech.*, 1956, **8** (2), AIMME Tech. Paper No. 4205, 50–8.—A test pit was constructed of limestones of 5 different porosities to simulate borehole conditions. The limestones were saturated with fresh water, and aluminium-lined "wells" of 6, 8, and 10 inches internal dia were provided. Neutron logs were run, and the following conclusions reached by using suitable methods. Variations in borehole dia are important, and should be allowed for, even though the sonde is believed normally to be at the well wall. The presence of casing and cement affects the results, but variations in mud density may be neglected. The counting rate increases with increase in mud salinity, but the effect is unimportant except at high salinities. For empty holes the log interpretation is difficult when hole dia exceeds 6 inches, but increased spacing may help. When the thickness of the formation exceeds *ca* 4 ft no correction is needed when normal logging speeds (1800 ft/hr) are used. Movement of the sonde causes a shift of the peak upwards from the centre of a thin bed and also reduces its amplitude, and these effects become greater with increased logging speed and time constant.

Tests in a well which was reamed after the initial run were in good agreement with lab data. G. D. H.

1155. How to perforate your well to prevent water and gas coning. P. E. Chaney *et al.* *Oil Gas J.*, 7.5.56, **54** (53), 108.—The results of mathematical and potentiometric studies of water and gas coning are given, together with a set of curves by which max water-free or gas-free oil production rates can be determined for wells having a gas–oil level, water–oil level, or both. 7 main conclusions are given: (1) perforations in a well having a slight level should be placed as far away as possible from the level; (2) there is an optimum position for perforations to allow greatest water-free and gas-free production; (3) the optimum position for a sand with oil and gas levels requires the distance between the centre of the perforated interval and the gas–oil level to be 35–45% of the total oil column thickness; (4) the smaller the perforated interval, the greater the "free" production rates, but an interval of less than 10% of the oil column limits the productive capacity of the well; (5) an impervious barrier between perforations and the gas or water level acts as a shield against gas or water entry; (6) existing coning may be eliminated by shutting in and then reopening at a lower producing rate; and (7) higher production rates than those shown in the curves can be obtained where horizontal permeability is greater than the vertical. C. A. F.

1156. Elements of fluid mechanics in porous media. A. Houpeurt. *Rev. Inst. franç. Pétrole*, 1955, **10** (6), 553–76.—The equation of continuity and the generalized Darcy equations are combined, and the partial differential equations are derived for incompressible fluids, for slightly compressible fluids, and for compressible fluids.

The derivation of particular solutions of the differential equations is examined for various cases: one, 2, or 3 spatial variables with and without time involved. Duhamel's theorem for transient movements is given, and Bessel's equations are introduced into the problems. G. D. H.

1157. California's biggest water-injection project. D. H. Stormont. *Oil Gas J.*, 14.5.56, **54** (54), 122.—Techniques used in the water flood project at Russell Ranch field, California, are briefly described. The field was found in June 1948, and the Dibblee zone, the main pay, was unitized in 1950. Pressure maintenance, started prior to unitization, is continuing and full-scale water injection was started in 1955 following a successful pilot flood. The structure is a warped monocline faulted up-dip with average net productive sand of *ca* 125 ft.

Ca 22,000 b.d. of brine and shallow well water is currently being injected, and it is planned to increase this to ca 70,000 b.d.

Photographs of installations and a structure map of the field are included. C. A. F.

OILFIELD DEVELOPMENT

1158. What's the outlook for the Permian basin? W. E. Dougherty. *Oil Gas J.*, 7.5.56, **54** (53), 179.—The Permian basin of W. Texas and SE. New Mexico is one of the most important producing provinces of the U.S.A., and contains over 20% of the reserves of the country. The future outlook for the area is briefly considered, and several trends are indicated: the rejuvenation of old fields with new techniques, extending the limits of proven fields, exploring for and drilling new structures in established areas, deeper drilling in old fields, wildcatting, and evaluation of subsurface data for locating stratigraphic traps. Geological and geophysical activity have steadily increased to a high level in recent years, but most seismic work is still being carried out in the densely drilled parts of the basin. C. A. F.

1159. Michigan looks west. D. Carr. *Oil Gas J.*, 28.5.56, **54** (56), 185.—Recent exploration in the Michigan basin has been centred about the W. and W.-Central parts of the basin. Although only 2 new fields and one important field extension have been found so far this year and exploration has been generally unsuccessful for some time, fairly active wildcatting is expected for many years. Considerable development is expected this year of the Huber-Traverse field, Newaygo county, which was discovered in 1955.

The Michigan basin was one of the first areas of the U.S.A. to be found productive, and the fields occur along anticlines in Ordovician, Silurian, and Devonian limestones and dolomites. C. A. F.

1160. Illinois production jumps 21 per cent with credit going to new drilling and to water flooding. Anon. *Oil Gas J.*, 30.4.56, **54** (52), 120.—The history of oilfield development in Illinois is described and future outlook reviewed. Production in the state in 1954 was 67 million brl, increasing to 81 million brl in 1955. Pay sands are numerous and shallow, and water flooding is being used in many fields. The main types of reservoir rocks are limestones and sandstones, with pools in structures and in stratigraphic traps.

A chart showing Illinois oil production since 1905 and maps and a cross-section are included. C. A. F.

1161. Drilling stepped up in South China sea. Anon. *Oil Gas J.*, 14.5.56, **54** (54), 118.—Further offshore wells are planned for the Seria field in Brunei, British Borneo, where several offshore wells have already been successfully drilled. The land-based productive area of Seria has been defined by 290 wells, offshore oil is now required to maintain production, and, apart from a wildcat at Jerudong, no new fields have been found in recent years.

Production at Seria comes from 2 main zones; the upper at 2000–3000 ft produces 17° asphaltic oil, and the lower, at 5000–7000 ft, 38° waxy oil. At Jerudong in 1955 a wildcat produced over 3500 brl on test, but stepouts have been dry. C. A. F.

TRANSPORT AND STORAGE

1162. The 20,000-ton tanker *Andreas*. Anon. *Mot. Ship*, June 1956, **37** (433), 68.—M.T. *Andreas* follows normal tanker design in most respects, but an effort has been made to improve trim conditions by raising the tops of the centre tanks and one wing tank to the level of the poop deck. The propelling engine is a standard 2-stroke single acting type (VGS9) built by Götaverken, developing 8150 b.h.p. at 112 rev/min. It has 9 cyl of 760 mm dia and a piston stroke of 1500 mm. It is arranged for operation on heavy oil. Photographs and a plan of the vessel are included. D. K.

1163. A new lining for ships' tanks. Anon. *Mot. Ship*, June 1956, **37** (433), 74.—Prodorite Ltd, Wednesbury, Staffs, have developed Prodorfilm, a poly-urethane resin for lining ships' tanks. Metal surfaces must be thoroughly cleaned, preferably by shot blasting, before applying the protective lining. The final thickness of the lining should be 0·005 inch. Admiralty and RAF fuel tanks have been lined with Prodorfilm and have given satisfactory service for some years. An apparatus used for testing the lining is described. D. K.

1164. Tank cleaning in oil tankers—practical aspects. A. G. Arend. *Petroleum, Lond.*, 1956, **19** (2), 49.—The practical points which require attention in order to ensure safety and reliable cleansing of surfaces are described in detail. J. B. S.

1165. Slack loops and tie-ins in pipeline construction. J. W. Jones. *Fluid Handl.*, 1956, 90–5.—In spite of increasing mechanization in pipeline construction, provision of slack loops to allow for temp changes is largely based on individual experience. The guiding principle is to keep the pipe under compression, not tension, and right and wrong methods are illustrated. Making of tie-ins, *i.e.* welding together of 5000–8000-ft sections, calls for great skill; again some "do's and dont's" are given. W. A. M.

1166. Design of overhead pipelines. R. J. Sweeney. *Chem. Engng*, 1956, **63** (3), 199.—The methods of calculating the spacing of pipe supports to allow for wind loading and gravity loading are given. The deflection, important in draining, is also calculated. D. J. S.

1167. Electric heating of oil. M. Simonovic, M. Tasic, and P. Tanaskovic. *Nafta (Yugoslavia)*, 1956, **7** (3), 78–83.—Methods and setting up of electric heating for tubings and pipelines used in the exploitation of paraffin oils are described. A detailed description of the system for the electric heating of the Jermenovci oilfield pipeline, together with the results achieved by this method, are given. (Authors' abstract.)

1168. Gas pipelines ought to be safe and economical. S. Lazic. *Nafta (Yugoslavia)*, 1956, **7** (4), 97–102.—The extraordinary significance of the installation of gas pipelines is pointed out, and the basic requirements which gas pipeline construction should fulfil are emphasized. Various alternatives for construction, as well as the choice of the best, are illustrated in concrete cases. A costs statement of one gas pipeline is analysed on a Yugoslav example. (Author's abstract.)

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1169. Continuous automatic sampling—3. R. P. Johnson. *Oil Gas J.*, 23.4.56, **54** (51), 119.—The application of automatic sampling in pipelines and processing to obtain truly representative samples is dealt with. Installation, operation maintenance, and testing are described. G. A. C.

1170. Save money on bubble-cap columns. T. J. Walsh and P. G. Lafyatis. *Chem. Engng*, 1956, **63** (4), 193–6.—The article gives a simple procedure for checking the capacity of bubble-cap columns based on the calculation of the total head of liq in the downcomers. Charts are included from which the capacity of any tray design can be estimated under varying conditions of loading. D. H. A.

1171. Heat transfer problems. W. W. Akers and O. A. Sampson. *Petrol. Refin.*, 1956,. **35** (3), 152.—A physical factor is defined for use in the Dittus–Boelter equation for the H.T.C. for turbulent flow through tubes. This factor is dependent only upon the gas, temp, and pressure, and is given for hydrogen–hydrocarbon mixtures as a function of the average mol. wt. and temp for pressures up to 1000 p.s.i. It should be noted that these curves are not suitable, however, for other gases such as nitrogen and carbon dioxide. R. L. R.

1172. Utilities system for a 30,000 barrel-per-day refinery. C. E. Peterson. *Mech. Engng, N.Y.*, 1956, **78** (5), 430.—Background and factors which lead to the selection of equipment are given, together with a brief description of plant lay-out. The "by-product" power cycle has been employed. This cycle uses high-pressure steam for the turbine generator, exhaust from the turbine is used for process and mechanical drivers through the refinery. Steam needed in addition to the turbine exhaust is diverted through pressure-reducing valves and heat-reducing stations to the same system as the turbine exhaust. A low-pressure-exhaust steam system is used for heating and to receive exhaust from refinery turbine drivers. D. K.

1173. Materials of construction for hydrogen. B. B. Morton. *Petrol. Refin.*, 1956, **35** (3), 164–6.—This article is concerned with the selection of suitable material of construction to prevent hydrogen decarburization, blistering, and cracking. The use of alloys and steels is described in hydrogen-producing plant with wall temp of the order 1700°–1900° F and with an oxidizing atm of steam inside and flue gases on the outside.

In order to avoid decarburization the carbon in the steel or alloys must be stabilized by using alloying elements that form stable carbides, *i.e.* chromium, vanadium, or molybdenum, and the wall temp kept as low as possible by suitable insulation.

Plastic deformation producing blisters and possible stress rupture can be best prevented by the use of liners of resistant metal, such as titanium, vanadium, or austenitic stainless steels within a carbon shell. These liners must, however, be vented to prevent attack of the outer shell, thus ruling out the use of bonded or clad liners.

Finally, to avoid cracking of metal parts by hydrogen attack it is well to avoid contact with moist hydrogen containing acid gases or fluids. Since failure is a function of the presence of hydrogen and a high order of tensile stress, low stresses in the metal are desirable. R. L. R.

1174. Heat capacity chart for hydrogen and hydrocarbons. W. W. Akers and H. F. Ralph. *Petrol. Refin.*, 1956, **35** (3), 151.—This chart presents the specific heat of hydrogen and hydrocarbon vapours as a function of the temp at low pressures, the heat capacity of mixtures being found from the mixture rule. R. L. R.

1175. Graphical design calculations for extraction with reflux. S. R. M. Ellis. *Chem. Proc. Engng*, 1956, **37**, 123–5.—Calculation of No. of equilibrium stages necessary in reflux liq extractions can be simplified by using a special form of the Ponchon and Savarit construction with reflux–concn diagrams (with solvent and solvent-free). Continuous countercurrent multi-stage extraction with extract reflux of a mixture of methyl*cyclo*pentane and *n*-hexane with aniline is fully worked out. Results are in close agreement with those obtained by other methods. Reflux-concn method can also be applied to dist, gas absorption, leaching, etc. W. A. M.

1176. A modern flare system. J. R. Hannaman and A. J. Etingen. *Petrol. Refin.*, 1956, **35** (2), 143–6.—A complete relief and blowdown flare system for a 14,000-b.d. Platformer, Unifiner, Unisol, and sulphur plants is described. The system includes a smokeless flare stack, flare pit, knockout tanks, a slops pumping system, seal drum, and full instrumentation and alarms pertaining to the equipment. The smokeless stack, 15 ft high, is fed with steam through 27 steam jets set in an alloy ring manifold, and is fitted with constant pilot igniters. The system is designed to operate on either fire blowdown or cooling water failure load, depending which controls the unit involved. R. L. R.

1177. Finite difference calculations: new look at batch extraction. J. G. Knudsen. *Chem. Engng*, 1956, **63** (4), 188–92.—The author, by the application of the calculus of finite differences to the batch extraction of a solute from a soln using a solvent immiscible in the soln, has constructed charts for the rapid solving of problems where the distribution is a linear function of the concn in one of the phases. The charts can be used to find either the number of stages required to go from one concn to another, or the change in concn for a given number of stages. The same approach can be used in other stagewise contact operations, such as dist, evaporation, vaporization, absorption, adsorption, leaching, and sublimation. D. H. A.

1178. Oil refining in Australia. I. V. S. Swaminathan. *Engineer, Lond.*, 1956, **201**, 282–3.—4 new major refineries have been commissioned in Australia in the last 2 years: British Petroleum Co at Kwinana (3 million tons p.a.), Shell at Geelong (1·7 million tons p.a.), Standard Vacuum at Altona (an extension of a previous plant, now 1·1 million tons p.a.), and Caltex at Kurnell, N.S.W. (1·1 million tons p.a.). Some details and photographs of the Kwinana refinery are given. A. C.

DISTILLATION

1179. Chemical and hydrogen treating. W. W. Scheumann. *Petrol. Process.*, 1956, **11** (4), 53–7.—Various factors have led to the better middle dist finishing in recent years. General mention is made of the finishing of kerosine, domestic heating oils, light diesel fuels, and jet fuels. Kerosine from a good quality raw stock requires no other treatment than sweetening, usually by plumbite treatment. Medium quality raw stocks require additional treatment to improve colour stability and burning characteristics. Kerosine from low quality raw stocks requires heavy sulphuric acid treatment or treatment with a selective solvent. A new process of great promise employs mild cat hydrogenation. Dist heating oils from good quality raw stocks require no treatment other than moisture removal and caustic washing. Medium quality stocks require removal of mercaptans and very careful blending. Low quality raw stocks are difficult to finish owing to more nitrogen and sulphur content, higher nitrogen and sulphur content, and high concn of aromatics. J. H.

ABSORPTION AND ADSORPTION

1180. Hydrogen sulphide data. D. S. Hoffman and J. H. Weber. *Petrol. Refin.*, 1956, **35** (3), 213–15.—Data for absorption or stripping processes involving hydrogen sulphide removal are given. The standard state fugacity values of the liq and vapour phases from 76·4° to 212·7° F and at pressures up to 1000 p.s.i.a. are presented; fugacities in the hypothetical state are shown to be consistent with those in the stable state. Also vaporization equilibrium constants are reported in both tabular and graphical form. R. L. R.

CRACKING

1181. Reactor design for catalytic reactions. I. T. E. Corrigan and W. C. Mills. *Chem. Engng*, 1956, **63** (4), 197–202.—Lists are given of the factors to be considered in determining the type of cat reactor required and the minimum essential preliminary data necessary to begin design calculations. The relative advantages of longitudinal over back-mixing fixed-bed reactors and of fixed-bed, moving-bed, and fluidized-bed reactors are discussed. The best reactor for many purposes is one utilizing a longitudinal fluidized bed. The factors for consideration in designing such a reactor are stated. D. H. A.

1182. Stress-relieved 200 feet up. Anon. *Chem. Engng*, 1956, **63** (4), 132–4.—The reactor portions, each weighing 250 tons, of 2 Houdriflow cracking units have been stress-relieved after installation by blowing the flue gases from refinery gas burners at 1400° F through the insulated reactors. D. H. A.

CHEMICAL AND PHYSICAL REFINING

1183. Sulphur compounds from petroleum. L. F. Hatch. *Petrol. Refin.*, 1956, **35** (2), 138–42.—The article describes the occurrence, synthesis, and uses of sulphur cpds found in petroleum, ranging from the naturally occurring hydrogen sulphide and mercaptans to the oxygen-containing cpds formed by chemical reaction and the alkyl hydrogen sulphates and dialkyl sulphates, intermediates in the preparation of alcohols from olefins. R. L. R.

1184. Removal and converting mercaptans. H. E. Walker and E. B. Kenney. *Petrol. Process.*, 1956, **11** (4), 58–66.—The formation of contaminants in unfinished gasolines, formed by chemical changes taking place during primary processing, has led to the treatment of the crude to remove or convert the sulphur, oxygen, and nitrogen cpds. The contaminants may be grouped into acidic (H_2S, mercaptans, naphthenic acids, phenols), basic (nitrogen bases), and neutral (sulphur excluding acidic) categories. The nitrogen base problem has not been deemed significant, and the removal of neutral sulphur cpds is not required in the majority of U.S. refineries. Various methods are reviewed for removal or conversion of acid contaminants. J. G. H.

SPECIAL PROCESSES

1185. Hydrogen peroxide. L. F. Hatch. *Petrol. Refin.*, 1956, **35** (3), 197–200.—The production, reactions, and uses of hydrogen peroxide are described. 2 processes are given, from propylene by liq phase oxidn, with oxygen, of *iso*propyl alcohol, and from air and hydrogen by cat reduction followed by oxidn of hydroquinone. Reactions as peroxides and per-acids in organic synthesis are given, and the special carbon–carbon double bond reactions forming oxiranes and/or glycols. The epoxy cpds and glycols resulting have many uses, forming excellent stabilizers, plasticizers, insecticides, lubricants, surface active agents, etc. R. L. R.

PRODUCTS

CHEMISTRY AND PHYSICS

1186. Thermodynamics of the partial oxidation of methane with pure oxygen. A. Fiumara and G. Salvi. *Riv. Combust.*, 1956, **10** (4), 267–84.—The authors have carried out thermodynamic research on the reaction occurring in partial conversion of methane with pure oxygen or with air, and determined the reaction gas composition at equilibrium, for temp ranging from 800° to 1400° K, at 1 atm pressure, and for O_2–CH_4 ratios of from 0·455 to 0·715. The minimum O_2–CH_4 ratios by different temp were also determined above which no elemental carbon is formed. (Authors' summary.)

1187. Transformation of hydrocarbons with metal oxide base catalysts at high temperature and hydrogen pressure. N. I. Shuikin. *Riv. Combust.*, 1956, **10** (4), 249–66.—The author submits the result of his investigations into the behaviour of penta- and hexa-cyclic ring naphthenes and of *n*-paraffins, in the presence of metal and metal oxide base cat, at high temp and under high hydrogen pressure. Experiments were made with platinum, palladium, rhodium, and ruthenium; the behaviour of methyl*cyclo*pentane, *cyclo*pentane, *cyclo*hexane, *n*-hexane, *n*-heptane, *n*-octane, and *n*-decane was also investigated. Diagrams are suggested for the principal reactions which lead to the formation of isomers and aromatic hydrocarbons, as well as breakdown products, starting from the different hydrocarbons studied. (Author's summary.)

ANALYSIS AND TESTING

1188. Analysing hydrocarbon mixtures. W. J. Podbielniak and S. T. Preston. *Oil Gas J.*, 16.4.56, **54** (50), 211.—A new thermal conductivity cell for dist equipment and vapour-phase chromatographic equipment for analysing hydrocarbons are described. G. A. C.

1189. Mechanical stability of greases: bench tests versus field service. S. F. Calhoun and F. E. Woodward. *NLGI Spokesm.*, 1956, **19** (10), 8–10.—The necessity for establishing reliable bench test methods as substitutes for the more expensive field tests is remarked, and details are presented of bench tests on MIL-G-10924 Amendments 1 and 2 greases using the ASTM Worker and the Shell Roll Tester. Comparison of these results with those obtained on the field test programme indicate a close agreement. J. G. H.

1190. Interpretation and significance of tests indicating the concentration of polar compounds in transformer oil. R. W. Johnson. *Power App. & Systems (A.I.E.E.)*, 1955, 774–81.—Index, "specific orientation polarization," relating ε, d, and n of an oil and acting as measure of aromaticity is proposed. S.O.P. $= p_s = p - p_d$, where

$$p = \frac{\varepsilon - 1}{\varepsilon + 2} \times 1/d,\ p_d = \frac{n^2 - 1}{n^2 + 2} \times 1/d.$$

All const measured at same temp (*ca* 25° C). p_s is practical gauge of degree of oxidn of transformer oil, and can be used to predict remaining service life, on following basis:

$p_s < 0{\cdot}0100$ large fract of original life left, $0{\cdot}0100 < p_s < 0{\cdot}0150$ small fract of original life left, $p_s > 0{\cdot}0175$ negligible useful life remaining. Comparison made with IFT, which is more sensitive for new oil but which decreases asymptotically, hence life of oil with low IFT cannot be predicted. Suggestions are made for improving IFT significance by expressing test results as some function of IFT. V. B.

1191. Strength properties of polyethylene-coated papers. K. A. Arnold. *Mod. Packag.*, 1956, **29** (8), 138.—New dynamic test methods are described which support field data indicating that a multiwall bag with polyethylene-coated paper ply has greater shock resistance than conventional paper tests indicate. The Frag tester, in which repeated impact is caused until failure occurs, is described. A table gives physical tests on uncoated, polyethylene-coated, and asphalt-laminated papers. G. A. C.

1192. The effect of hydrogen on metals. H. C. van Ness. *Petrol. Refin.*, 1956, **35** (3), 160–3.—This article appraises our present state of knowledge of the effect of hydrogen embrittlement and attack on the physical properties of metals. These are mainly a lowering of the ductility, which is readily detectable by a bending test or by elongation and reduction of area tensile test, and a lowering of the tensile strength of the metal, which is dependent upon the degree of embrittlement, but failure usually occurs at different points on the same stress–strain curve. It is found that the hardness of the metal is apparently not affected by hydrogen embrittlement. R. L. R.

1193. Viscosity. W. W. Akers and R. A. McAllen. *Petrol. Refin.*, 1956, **35** (3), 153.—Curves are presented for the visc of hydrogen and hydrogen–hydrocarbon mixtures against temp with average mol. wt. as a parameter. The effect of pressures up to 1000 lb/sq. in. has been neglected; references are given for correlations at higher pressures. R. L. R.

1194. The breaking of stable emulsions. W. Szwed. *Nafta (Krakow)*, 1954, **10**, 285–6.—Occasionally crude oil has with it up to 10% of water (or ½% NaCl), and this forms a persistent emulsion. The standard method of estimating water by centrifugeing gives results only 50–60% of those obtained by the Dean and Stark method. Apart from separation on standing at 20°–40° C there are the following methods: (1) heating to 150° C at 4–6 atm; (2) centrifugeing at 40°–60° C at 10,000–20,000 rev/min; (3) Cottrell electrostatic method; (4) addition of a strong electrolyte; (5) addition of a sulphonic, naphthenic, or fatty acid soap. All these methods have recently been tried by the Polish IP, with the result that only salts of naphthenic acids and one of alkyl-sulphonic acid known as "Mersolan" are sufficiently effective to lower the water content to 0·1%. "Mersolan" is cheaper, can be applied in a smaller quantity, and the water phase, which separates in a few days, can be used to break further quantities of emulsion. M. S.

1195. Estimation of free bases and high molecular weight organic acids in solid greases. S. Patzau. *Bull. Polish Inst. Petrol.*, 1954, **4**, 12 (suppl. to *Nafta (Krakow)*, 1954, **10**).—3 methods were investigated: (1) grease is dissolved by warming with a mixture of light petroleum and 60% ethanol and titrated with alc KOH using phenolphthalein; (2) grease is dissolved in a mixture of light petroleum and saturated NaCl aq soln and then titrated as in (1); (3) grease is dissolved in the cold in light petroleum, and then 92% strong ethanol with a few drops of phenolphthalein is added. Excess of N/2-HCl is added to basic soln, which is then boiled to expel CO_2 and "back" titrated with alc KOH. Only the last method gives true free alkali even after prolonged exposure to atm, but all methods fail to give free acids in presence of their Pb, Al, or Zn salts. M. S.

1196. Contribution to estimation of total sulphur in solid fuels. W. Schuhknecht and H. Kunz. *BrennstChemie*, 1956, **37** (5–6), 78–84.—Seuthe's method for estimating total S in solid fuels is examined critically. Low results arise through S retention in the combustion residues and H_2SO_4 in the combustion tube, also incomplete absorption of S-cpds present, in the absorption bulb. High results are due to neutralization of HCl and HNO_3 in the absorption bulb cont. A process is described which eliminates these errors. A Krekeler apparatus replaces the Seuthe tube and absorption bulb. Combustion takes place with ferric phosphate addn, and the H_2SO_4 formed is estimated by indirect conductometric titration. R. T.

CRUDE OIL

1197. Tracer elements in ashes from Polish crudes. J. J. Glogoczowski. *Bull. Polish Inst. Petrol.*, 1954, **4**, 11–12 (suppl. to *Nafta (Krakow)*, 1954, **10**).—Correlation of horizons can be achieved by identification and estimation of mutual ratio of some 20 metals and metalloids. Of these Si, V, and Na are abundant in some crudes and rare in others, whilst Al, Ni, Cu, and others like K are non-characteristic. Thus ratio V : Ni or V : Cu varies a lot (from 2·5 to 7 or from 13 to 520 respectively). Vanadium can perform the function of Fe in the blood of some animals, but is largely absorbed by rocks through which crude oil seeps. It is associated with bitumens and deposits rich in them. Ni is associated with higher H : C ratio. Polish crudes contain Ni, Co, V, Ti, Mg, Ca, Si, Al, Cu, Cr, Cd, Be, Na, Sn, Ag, Mo, Ba, and Bi in the order of diminishing quantities. Work is still going on in this field. M. S.

GAS OIL AND FUEL OIL

1198. The influence of superheater metal temperature on the acid dew-point of flue gases. W. Burnside, W. G. Marskell, and J. M. Miller. *J. Inst. Fuel*, June 1956, **29** (185), 261.—Experiments are described which were made in a gas-fired pilot-scale unit to study the change in acid dew-point of flue gases passing through a bank of superheater tubes, when the tube metal temp was varied from 850° to 1250° F. 2 methods were used. The concn of SO_3 in the flue gases was determined by chemical analysis, and the dew-point was measured directly with an external dew-point probe above and below the tube bank. Results indicated that at metal temp around 1200° F increases of dew-point of up to 20° F can occur. The effect is less with metal temp in the range of 1000°–1100° F. During the investigation a relationship between SO_3 concn in flue gas and acid dew-point was obtained, and this is compared with results of other workers. 13 literature refs. D. K.

1199. The radiation from turbulent jet diffusion flames of liquid fuel–coke oven gas mixtures. Anon. *J. Inst. Fuel*, Jan. 1956, **29** (180), 23.—The third series of reports of the work of the Flame Radiation Research Joint Committee are presented. The subjects discussed are: (1) the purpose of the trials and practical implications of the results; (2) methods of increasing the emissivity of coke-oven-gas flames without addition of liq fuels, by M. W. Thring; (3) a description of the way in which the trials were conducted and their results, by M. Rivière. D. K.

1200. A new way to clean up fuels. P. J. McGuire and H. A. Price. *Petrol. Refin.*, 1956, **35** (2), 125–6.—A prototype plant for the removal of wax, dirt, and water from fuels is described. The equipment consists of 3 separate zones contained in a 48-inch dia column, 17 ft high. The dirty fuel is fed in at the bottom and passes first through a water wash tank and thence to a coalescing zone, where a large surface area is presented by wide, flat, rectangular, filter leaves. A desiccate bed of half-ground salt is used for final dehydration. R. L. R.

LUBRICANTS

1201. Evaluating bearing materials under boundary lubrication. B. Lunn. *Lubric. Engng*, 1955, **11** (4), 255–60.—A new method of predicting bearing metal behaviour under boundary lubrication conditions is outlined. The equipment used, that of Kauppi and Pederson, originally developed for wear experiments with silicones, is described, together with the

electrical contact method of measurement, the results being given in terms of "L-value." Correlation of results so obtained with technical experience with babbit metals showed good agreement. The possibilities of the test as a means of evaluating lubricants is touched upon, together with the effect of high temp anti-oxidant additives in the lubricant used. J. G. H.

1202. Difluorodichloromethane (as a boundary lubricant for steel and other metals). S. F. Murray, R. L. Johnson, and M. A. Swikert. *Mech. Engng, N.Y.*, 1956, **78** (3), 233.—Experiments are described which determine the ability of difluorodichloromethane to lubricate various metals which could be used for bearing surfaces in turbines. A kinetic-friction apparatus with a hemispherical specimen sliding on a rotary disk was operated in an atmosphere of the halogenated hydrocarbon. Materials studied included combinations of steel types and hardness and possible cage materials on hardened steel. After a brief run in period, friction force was measured at a sliding velocity of 120 ft/min and with a load of 1200 g (initial Hertz stress 158,000 p.s.i.). The data given were at room temp. Results with various lubricants are given in tabular form. D. K.

1203. Miles per quart + . . . 3. The petrol engine. J. M. Nuttall. *Sci. Lubric.*, 1956, **8** (2), 16–24.—The severe demands made on lubricants in the modern petrol engine are stressed and the necessity of additive-containing oils remarked. Lubrication and operational problems associated with crankcase, bearings, pistons, cyl, valve and rocker mechanisms, and sparking plugs are discussed, together with lubrication systems and oil filters. J. G. H.

1204. Theory of hydrodynamic lubrication in parallel sliding. V. H. Brix. *Engineer, Lond.*, 1956, **201**, 254–5.—Comment, with experimental evidence, on W. Lewicki's article under the same heading (Abs. **744**, 1956), indicating the powerful "shear-vortex" formation at the leading edge of sliding members such as piston rings, plain thrust bearings, etc. A. C.

1205. Theory of hydrodynamic lubrication in parallel sliding. W. Lewicki. *Engineer, Lond.*, 1956, **201**, 486–7.—A reply to correspondence from V. H. Brix (*cf.* preceding abstract) indicating that the frictional behaviour described was due to convergent rather than parallel sliding. A. C.

1206. Menrow system of conditioning steam turbine lubricating oils. Anon. *Fluid Handl.*, 1956, 96–8.—2 alternative Menrow systems (based on O. E. Nekolla's patents) for reconditioning turbine oils are available. In the "dry type" dehydration is effected by means of a precipitator and 2 dehydration chambers. In the "wet type" vac dehydration with the aid of a precipitator and heater is used. Both systems include a de-aerator-separator for air and free water, a heat exchanger for coagulation, and a pressure filter. Systems are designed for *in situ* reconditioning. Details are given of a 7-months test of "dry type" equipment at Battersea power station; analyses are given of removed material, and of oil during the test period. W. A. M.

1207. Refining of lubricating oils—conventional processing. V. A. Kalichevsky. *Petrol. Engr*, 1956, **28** (2), C11–14.—The chemical composition of the lub oil fraction is considered broadly and the difference in constituents—asphalt, wax, etc., in different base crudes shown. Acid treatment is then discussed in some detail—temp agitation, etc., and also 2 methods of clay treatment—clay contact and clay percolation process. De-asphalting of lub oils by dist and precipitation is also considered. J. B. S.

1208. Neutrons, gamma rays and wear. A. Hundere, G. C. Lawrason, and J. P. O'Meara. *Lubric. Engng*, 1955, **11** (4), 230–7.—The historical development of radio-active techniques for wear evaluation is briefly summarized and safety precautions necessary in the handling of radio-active materials are set out. Methods used for the activation of parts are outlined, and the test procedures and instrumentation employed are described. Applications of radio-active techniques to the study of corrosive wear, load carrying ability, to the effect of dust content on intake air on piston ring wear, and to gear wear are discussed in some detail. J. G. H.

1209. Combating cylinder wear. Anon. *Mot. Ship*, March–April–May 1956, **37** (432), 19.—Extracts of paper to Inst. Marine Engrs read on 28 Feb. 1956 by M. J. van der Zijden. The use of emulsion lubricants in low-speed marine diesel engines to combat cyl wear is discussed. Expenses with conventional lubricants are compared with those with emulsion lubricants. Despite the unconventional nature of the emulsion oil, the author says its use has not presented any serious difficulties. An appendix gives notes on the application of the emulsion lubricant. Discussion of the paper is included. D. K.

1210. Cylinder liner wear. B. Olsson. *Mot. Ship*, June 1956, **37** (433), 93.—The effect of fuels of various origins on cyl liner wear is discussed, and it is concluded that: (1) except for purely operating conditions the quality of the fuel oil determines the extent of cyl wear; (2) fuel oil quality varies widely, the inferior quality being in the majority; (3) unalloyed pig iron is no longer suitable for cyl liners, when used with the diesel oils available; (4) the transition to heavy oil increases the need for special steps to be taken to reduce cyl wear.

Methods of reducing cyl wear considered are: use of cyl liner materials with better wear resistance, use of chromium-plated cyl liners, use of chromium-plated piston rings, and more efficient lubricants and lubrication. D. K.

1211. Hermetically sealed refrigeration compressor lubrication. K. Borah. *Lubric. Engng*, 1955, **11** (5), 319–24.—Recent developments in mechanical refrigeration installations have placed an increasingly severe load on the lubricants employed and have necessitated the use of oils with marked characteristics, such as stability, adequate low temp properties, low volatility, high visc, and non-foaming tendencies. These properties are discussed in detail, and the adequacy of existing tests is considered. J. G. H.

1212. New grease for high temperatures. J. P. Dilworth and J. R. Roach. *Petrol. Engr*, 1956, **28** (2), C8–10.—The performance of a new mixed soap–solid thickened synthetic oil grease is discussed. This is a non-silicone type oil and will lubricate ball bearings operating at ultra-high speeds over a temp range of −65° to 450° F. J. B. S.

1213. Forces responsible for lubricating grease structure. M. J. Vold. *NLGI Spokesm.*, 1955, **19** (1), 24–31.—A theoretical explanation of the yield value and consistency of greases based on London–van der Waals attractive forces and associated phenomena is presented, from which a method is derived describing practical grease properties in terms of curves of total interaction energy as a function of particle separation. Phenomena such as shear breakdown, age and work hardening, and thixotropy are explained on this basis, and the effect of particle size, as well as the chemical nature of oil and soap, on physical properties is indicated. J. G. H.

1214. Antioxidants for greases. S. F. Calhoun. *NLGI Spokesm.*, 1956, **19** (12), 8–28.—Stockpiling and the extended use of equipment with lubricated-for-life bearings has rendered increasingly necessary the incorporation of antioxidants in greases. Details are presented of examinations of 69 different cpds, with oxidn tests run at 210° and 250° F, with acid and base No. and copper corrosion tests for greases containing promising inhibitors and the results tabulated.

Most successful inhibitors were amines, especially phenylenediamines, with organo-sulphur cpds, phosphorus cpds, phenolic derivatives, and organo-silicon cpds showing marked promise. 28 refs. J. G. H.

1215. Thickener particle dimensions and lubricating grease consistency. R. H. Leet. *NLGI Spokesm.*, 1955, **19** (1), 20–3.—Previous workers have indicated the importance of thickener particle shape and interparticle attractions in grease consistency and flow behaviour. Present investigation of the effect of thickener-particle shape on lub grease consistency measures thickener particle dimensions of greases of known consistency, changes occurring upon working and ageing being measured from electron micrographs and correlated with consistency as measured by a penetrometer. Apparatus and procedure used are described, and the results obtained indicate 2 distinct types of consistency change during hardening: that arising from changes in particle shape and that resulting from interparticle attractions. J. G. H.

1216. Research on cutting fluids, tools, and machinability. Anon. *Petrol. Times*, 27.4.56, **60** (1532), 266.—The use of radio-active cutting fluids at A. Duckham's Nuclear Laboratories is described. By its technique the tool life for a particular metal, coolant, and a metal hardness and set of conditions are studied. G. A. C.

1217. Oil flow and film extent in complete journal bearings. J. A. Cole and C. J. Hughes. *Engineer, Lond.*, 1956, **201**, 255–8, 263–5.—Results are presented of a study of the oil films in glass journal bearings of standard clearance ratios (0·001 and 0·002), the oil film being photographed under varying conditions of speed, load, and oil supply pressure. Divergencies between theory and experiment are noted, and further investigation is planned (*cf.* Abs. **1239**, 1955). A. C.

BITUMEN, ASPHALT, AND TAR

1218. Bituminous soil stabilisation. J. R. Benson. *Rds & Str.*, 1956, **99** (5), 164–72.—Although soil stabilization began at least 15 years ago, present-day methods are backward. Lack of venture by highway engineers and the absence of co-ordination of past experience are thought to be responsible.

Primary soil stabilization methods of the cementation type are described, and secondary processes based on waterproofing methods are also enumerated. The latter include the formation of intimate mixtures between soil and asphalt, involving a protective film on a particle scale; mechanical stabilization, in which capillaries in the soil-aggregate mixture are plugged by asphalt particles; phase-mixed stabilization, nodules of plastic soil encased in asphalt; and membrane enveloping, whereby an entire fill may be wrapped in a protective membrane. Currently available products applicable to these methods are classified. S. L. C.

DERIVED CHEMICAL PRODUCTS

1219. Furfural taps new source. Anon. *Chem. Engng*, 1956, **63** (4), 126–8.—The first plant to make furfural from bagasse, a by-product of sugar refining, is described. The Central Romana By-Product Co's $7 million plant with a yearly output of 30 million lb is ideally situated next to a sugar mill at La Romana, Dominican Republic. The full-scale plant was successfully constructed without any previous pilot-plant experience. D. H. A.

CORROSION

1220. Corrosion testing at high temperatures. N. D. Greene. *Chem. Engng*, 1956, **63** (4), 175–80.—The basic problems involved in corrosion testing at elevated temp are examined with special reference to the test vessel, temp control, duration of test, and safety precautions. Descriptions of 3 methods of testing, with their relative advantages and disadvantages, are given. The relationship between the results of lab tests and actual process conditions is discussed, and a procedure is given for the selection of suitable materials of construction. D. H. A.

1221. Corrosion inhibitors in petroleum refineries. P. W. Sherwood. *Petroleum, Lond.*, 1956, **19** (2), 57–61.—Use of chemical inhibitors is a technique of rapidly increasing importance. The method is not new, but with the growth of the complexity of corrosion problems this technique has made rapid strides in post-war years. Inhibitors fall into 3 categories: anodic, cathodic, and organic inhibitors, all working on the principle of passivation. They all result in a reduction in maintenance costs provided they are correctly used. J. B. S.

1222. Gasoline plant corrosion. D. R. Fincher. *Petrol. Refin.*, 1956, **35** (3), 218–20.—General mechanism of corrosion of connecting lines, heat exchangers, and steam generating equipment is briefly described. Means of mitigating the corrosion are explained using neutralizing inorganic inhibitors, caustic volatile amine inhibitors, pH control, and sodium silicate. Case histories are used to show the various methods employed. R. L. R.

1223. Tank and underground pipe corrosion. W. A. Johnson. *Petrol. Refin.*, 1956, **35** (3), 216–17.—The article briefly describes means of mitigating corrosion of tanks or underground pipes using cathodic protection. This is obtained by passing a protective current from the ground to the metal either by using a rectifying system or by burying a galvanic anode, such as magnesium, zinc, or aluminium alloy, in the ground. A corrosion survey of the plant will generally indicate the best method of protection and the cost of installation. R. L. R.

1224. Induced alternating current used for cathodic protection of a coated pipeline. S. J. Bellassai. *Corrosion*, 1956, **12** (1), 1–3t.—After making repairs on a leak on a coated line through a salt marsh and paralleling a high voltage high line, it was found that although considerable gradients existed in the earth adjacent to the high line, there was no correlation in the measured quantities. It had been considered that natural rectification of the induced a.c. voltage was occurring. Coupons buried near the pipeline showed that it was predominantly positive to earth at the leak location, and a test ground bed was constructed to examine the feasibility of rectifying the induced a.c. It was found that a 5-amp, 15-V selenium stack, 10 3-inch × 60-inch graphite rods, and 500 ft of 1/0 copper cable would provide a circuit resistance of the required value to protect the line cathodically. W. G. R.

1225. High temperature hydrogen sulphide corrosion. E. B. Backensto, R. D. Drew, and C. C. Stapleford. *Corrosion*, 1956, **12** (1), 6–16t.—The effects of temp, pressure, and H_2S concn on the corrosion rate of a wide range of commonly used carbon steels and alloys were determined in lab tests. Only 18–8 Cr–Ni steel and higher alloys showed good resistance to this type of attack over a wide range of pressure, temp, and H_2S concn. It was found that Al-coated steels also showed very good corrosion resistance. W. G. R.

ENGINES AND AUTOMOTIVE EQUIPMENT

1226. Crankcase explosions. Anon. *Mot. Ship*, June 1956, **37** (433), 97.—Summary of paper read to the Institute of Mechanical Engineers recently, entitled: Crankcase Explosions: Development of New Protective Devices, by W. P. Mansfield. The paper deals with tests on a 6-inch dia crankcase explosion relief valve and the application of oil-wetted partition flame traps fitted in the crankcase of a 3-cyl diesel engine. D. K.

MISCELLANEOUS

1227. An oil man looks at atomic energy. J. T. Duce and A. H. Chapman. *J. Petrol. Tech.*, 1956, **8** (1), 15–18.—In estimating future energy requirements Putman assumed a world population of 5 billion in 2050, and that energy use will rise by 3%/year/head in the next century. The first figure may be too high, and the second too low. Nevertheless, estimates of future needs based on Putman's data are about the average of estimates based on other assumptions. In 2050 average energy use/head will be 12 times the 1950 figure, and increased efficiency will make it give 15 times the goods and services of 1950.

It is estimated that in 1970 27% of world energy needs will be met by oil and gas (20,500,000 b.d.) and 10% in 2050 (120,000,000 b.d.). If oil and gas resources represent 6·8 Q (where $Q = 10^{18}$ B.t.u.), they would be exhausted on the above basis in 2040.

There are big problems connected with atomic energy. Capital investment may be high ($200/kWH), but on some bases enriched U-238 may be equivalent to oil at $1.65/brl. The fission reactions which are now the main sources of atomic power use only 0·1% of the energy of the atom.

It seems likely that in 10 years the economic use of nuclear power will have been achieved; in 25 years it will supply a small part of the total electric power used; in 50 years it will supply much of the new electric power needs.

G. D. H.

1228. Activities of Petroleum Engineers' Association. Anon. *Nafta* (*Krakow*), 1954, **10**, 292–4.—The conference on Safety and Hygiene (3 Nov. 1954) noted low standards and resolved to spread the necessary information amongst workers whilst pressing for more government help. The Conference on Recovery of Gasoline from Natural Gas (11 Nov. 1954) stressed the urgency of the need for improvement and suggested more research and more training in this branch. The existing shortage of activated carbon must be overcome.

M. S.

1229. Current news. Anon. *Nafta* (*Krakow*), 1954, **10**, 295–6.—Production figures for 3rd quarter of 1954 were: crude—as planned; natural gas—2·4% above planned figures; light gasoline—10·1% high; drilling—14·7% high. Production cost (in Oct.) fell: crude—9%; natural gas—28·3%; gasoline—12·6%. Economy measures (Jan.–Oct.) saved Zl 1¼ million (£50,000). M. S.

1230. Industrial statistics. W. Volk. *Chem. Engng*, 1956, **63** (3), 165.—The basic concepts of average value and deviation from this mean are explained and illustrated. The significance of differences between 2 sets of data is discussed from the t-test and the chi-squared test, with examples. The correlation of results is discussed, starting with the Rank Correlation and the Sign Correlation, and then giving the method of least squares, from which it is shown how the variance of slope, intercept, and point values is obtained. Curve fitting is mentioned and analysis of variance is explained. Other important statistical methods are mentioned and a critical bibliography given. D. J. S.

1231. Egham technical service laboratories. Anon. *Fluid Handl.*, 1956, 131–4.—Illustrated description of Shell Chemical's new 23,000 ft² premises. W. A. M.

1232. New restaurant at oil refinery. Anon. *Caterer & Hotel Keeper*, 1956, **112** (1875), 77, 79.—Illustrated description of new canteen at Kent Oil Refinery, seating capacity 640, 2000 meals/day. V. B.

BOOK REVIEWS

Crude Oil Pipe Lines and Competition in the Oil Industry. Leslie Cookenboo, Jr. Cambridge, Mass: Harvard University Press; London: Geoffrey Cumberlege. Pp. 177. 32*s*.

Three-quarters of U.S. refineries' crude supplies are brought by pipeline. The network of crude oil pipelines represents today one of the major transport systems of the U.S.A. Most of these lines are owned or partly owned by a score or so of big integrated companies, and it is with the controversies raised by this fact that Mr Cookenboo's book is concerned. The perennial debate over proposals for "divorcement" (*i.e.* the compulsory splitting-up of the integrated operations of the larger U.S. oil companies) originates in circumstances peculiar to the U.S. industry and has little direct relevance elsewhere. To those interested in the U.S. pipeline divorcement controversy, however, the careful—though perhaps over-detailed—analysis presented by Mr Cookenboo, who is Assistant Professor of Economics at the Rice Institute, is a welcome addition to the literature.

The kernel of the book is the well-known fact that important economies of scale are obtainable by the use of big-inch pipelines, which have increased so rapidly in the post-war period. The operation of smaller pipelines, which the non-integrated companies could build if divorcement became U.S. public policy, would give rise to unnecessarily high transport costs. Another alternative, however, is presented by joint venture pipelines, in which both integrated and smaller non-integrated concerns are participants. A number of such pipelines has been built in the U.S.A. in recent years, and the author looks to an extension of this development—with, however, an added element of legal compulsion—to achieve the declared aims of the supporters of divorcement, *i.e.* freedom of entry for small firms into refining, without sacrificing the benefits of pipeline operations on a large scale. F. G. T.

Bearing Lubrication Analysis. R. R. Slaymaker. New York: John Wiley; London: Chapman and Hall, 1955. Pp. xiv + 108. 40*s*.

This is a difficult book to classify. It appears on the surface to contain the elements of bearing design treated in a simplified manner. Its elder brothers would be the well-known books by Norton and by Shaw and Macks.

Closer inspection, however, raises the question of whether the author is an altogether reliable guide to the design of bearings.

After an introductory 15 pages on the viscosity and other properties of oil, he deals with the hydrodynamics of journal bearings (40 pages). Without any serious discus-

sion, or any discussion at all, he (1) settles for the Sommerfeld conditions (p. 21), and (2) decides the oil flow, if not all from the central groove, is equal to one quarter of the swept volume (p. 59).

Both these assumptions are clearly vital to the application of theory to practice. The "examples of sleeve bearing design" (pp. 57–79) should thus be treated with some reserve.

The remainder of the book on bearing materials (pp. 82–92) and oil-less bearings (pp. 94–104) is interesting.

In conclusion, the book is stimulating in that it demands that the reader (and reviewer) should be very certain what the results contained in it have already presupposed. It does, however, make one wonder how valuable a book requiring such study really is to those whom the author addresses in his preface. A. C.

ADDITIONS TO THE LIBRARY

Standard Oil Company (Indiana): Oil Pioneer of the Middle West. Paul H. Giddens. New York: Appleton-Century-Crofts, Inc., 1955. Pp. xviii + 741. $7.50.

This book records the rise of the Standard Oil Company (Indiana) from a branch of the Standard Oil combine to the fourth largest industrial corporation in the U.S.A. Many great names are mentioned, and the inside story of a complex organization is told with clarity and accuracy. There are over 100 illustrations, several of them of historical interest, and the 23 charts present a picture of steady and continuous growth since the depression years.

Water Flooding of Oil Sands in Butler and Greenwood Counties, Kansas. J. P. Powell. Bureau of Mines Information Circular 7750, U.S. Dept. of the Interior, May 1956. Pp. 42.

British Standards.

B.S. 1952 : 1956. Copper Alloy Gate Valves for General Purposes. Pp. 26. 6*s*. net, post free.

B.S. 1953 : 1956. Copper Alloy Check Valves for General Purposes. Pp. 24. 5*s*. net, post free.

B.S. 2701 : 1956 Rees-Hugill Powder Density Flask. Pp. 12. 3*s*. net, post free.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1233. Recent trends in oil geology. 3. J. C. M. Taylor. *Petroleum, Lond.*, 1956, **19** (6), 197.—The principles and some of the geochemical methods of oil prospecting are described, and it is suggested that there may be renewed interest in these methods because of the increasing costs of present methods of exploration. It is also thought that the methods were formerly credited with too great an importance before they were sufficiently developed for their limitations to be understood.

The basic hypothesis of the geochemical methods requires that the cap rock allows minute amounts of hydrocarbons to escape upwards and that these can be detected at the surface.

C. A. F.

1234. Trends in analytical methods applied in stratigraphy. Y. Gubler. *Rev. Inst. franç. Pétrole*, 1956, **11** (1), 3–21.—In

oil geology the aim is progressively to locate in a sedimentary basin a facies suitable for production. Facies maps are prepared with this in view, and a step towards this calls for correlation. Correlation may be possible on a local or regional basis. Palæontological correlation, especially of well samples, makes much use of micro-fossils. Foraminifera, ostracods, spores, and pollens have proved most useful, and palynological work is being extended. Hystrichospheres, conodonts, and algæ also offer possibilities. When fossils are not available or when they are unsuitable, the form of the sand grains, and the heavy or light minerals may aid in correlation. In the finer sediments X-ray studies and differential thermal analysis can help, while in the carbonate rocks calcimetry, the amount of magnesium, the insoluble residues, and spectrochemical studies may provide data by means of which correlation is possible.

A series of different methods may be required in some cases to solve the problems, and the results of studies of the Jurassic of Mano in the N. of Aquitaine are briefly described.

G. D. H.

1235. Sieve residue logs. W. L. Buning. *World Oil*, 1956, **142** (5), 206.—A simple and rapid method of following closely the changes from clay to sand in unconsolidated beds during drilling is briefly described. Variations in the vol of residue left on screens by washing a standard quantity of cutting sample through a set of 3 sieves are plotted to give a sieve residue log.

The method can be used only on material that is friable, and the results have been found to be fairly accurate and reliable and the logs similar to electric logs, provided that the screen samples collected are representative of the beds at the bottom of the hole. Details of sieving and examples of the logs are given. C. A. F.

1236. Photogeology permits rapid mapping of wide areas. L. Brundall. *World Oil*, 1956, **142** (5), 310.—It is estimated that in 1955 over a million sq. miles were mapped by photogeology, which provides an economical method of large-scale mapping. Uses of the techniques are provision of regional coverage in areas where geological maps are not available, leads for further exploration by detailed methods, and provision of data for lease evaluation. Types of photograph are briefly discussed and some of the principles of photogeological interpretation described. C. A. F.

1237. Effect of clay and water salinity on electrochemical behaviour of reservoir rocks. H. J. Hill and J. D. Milburn. *J. Petrol. Tech.*, 1956, **8** (3), AIMME Tech. Paper No. 4223, 65–72.—The presence of clay minerals in reservoir rocks increases the difficulties in the quantitative interpretation of electric logs. *Ca* 45 samples from each of 6 typical sandstone formations, in addition to 4 limestones, were used for detailed studies involving measurements of porosity, permeability, resistivity, and electrochemical potential at various salinities, and cation exchange capacity. These data were used to test a variety of equations previously proposed, and it was found that the equations do not fit the data satisfactorily for all degrees of shaliness or ranges of brine salinities normally met in logging. An empirical relationship has been derived.

$$R_o/R_r = A(R_w/R_r)^{\,1\,+\,b\log R_w/R_r}$$

where R_r is 1 ohm-cm, the resistivity of an arbitrarily chosen hypothetical reference soln. A is a constant, and b is a further constant. R_o is core resistivity, and R_w water resistivity. If $F_a = \frac{R_o}{R_w}$, and is the apparent formation resistivity factor $F_a = F_{0\cdot01}(100\,R)^{\,b\,\log\,100\,R_w}$ in terms of ohm-meters. Furthermore, the formation resistivity factor, $F = f^{-m}$, f being the fractional porosity.

The S.P. and resistivity phenomena of the shaly samples were shown to be related to the cation exchange capacity/unit pore vol.

The present applicability of the relationships is confined to water-saturated rocks, and the resistivity of water-saturated rocks is obtainable when the average b value and formation factor at any salinity are available from other sources than the log in question. It is concluded that the S.P. opposite oil-bearing zones should be decreased by an amount related to the effective clay content and connate water saturation.

G. D. H.

1238. Is a salt dome's north flank its best prospect? W. C. Shead and E. R. Allen. *World Oil*, 1956, **142** (5), 158.—The results are reported of a statistical study of salt dome wells off and onshore in S. Louisiana to test the theory that N. flank wells were a better prospect than S. flank wells. On the basis of 7175 wells drilled on 73 salt domes it was found that the N. flank had a slight advantage, but the difference was statistically insignificant. The results are shown in tables giving numbers of oil, gas, and dry wells on N. and S. flanks of each of the 73 fields. C. A. F.

1239. Both structure and stratigraphy play major roles at Citronelle. N. S. Morrisey. *Oil Gas J.*, 4.6.56, **54** (57), 90.—The geology and development of the Citronelle field in SE. U.S.A. are briefly described. The field was found in 1955 and is developing into the most important field in the area. Production is controlled by structure and stratigraphy, and the pays are lenticular Rodessa sands at *ca* 11,000 ft in an anticline with at least 1000 ft relief.

14 wells have been completed, and the productive area is indicated to be at least 5000–6000 acres. The field is in the trend of important Lower Cretaceous fields which now extends 160 miles from Bolton SE. to Citronelle. Conditions along the trend are very favourable for Lower Cretaceous production, with marine beds grading updip to the NE. into a barren continental facies. C. A. F.

1240. Hunting's good in North Louisiana. N. S. Morrisey. *Oil Gas J.*, 18.6.56, **54** (59), 167.—Numerous pays and relatively low costs of drilling and exploration continue to encourage exploration in N. Louisiana, which has been explored for many years. Most drilling for production has been on the crests of salt domes, and the flanks have been ignored in many cases. The best future possibilities for the area are stratigraphic traps, exemplified by the Crane–Pettet trend, in which the Pettet field lies along a syncline. The regional geology of the area and producing zones are briefly outlined. Maps and cross-sections show how production is related either to structure or to stratigraphy in 3 fields. 2 refs. C. A. F.

1241. Why Louisiana's offshore prospects look better. Anon. *World Oil*, 1956, **142** (5), 163.—Offshore development in the Gulf of Mexico is outlined, and it is shown that river-deposited Miocene sands off the Louisiana coast offer good prospects. 30,000 ft of Miocene beds are believed to occur under the coast of SW. Louisiana in the Barton geosyncline, and many prolific Miocene fields have been found along the coast, particularly on the Mississippi delta.

Ca 800 wells have been drilled offshore in the Gulf, with *ca* 70% of them successful, despite a high proportion of wildcats. *Ca* 20 major offshore fields have been found, and total cost in offshore exploration to date is estimated at over $1 billion.

C. A. F.

1242. Louisiana and Texas offshore prospects. B. C. Belt. *J. Petrol. Tech.*, 1956, **8** (4), 17–19.—The first offshore oilfield was the Creole field of Cameron Parish, Louisiana, opened in March 1938, at a depth of 5110 ft. Geophysical work began *ca* 1945, and in late 1947 a discovery was made off Terrebonne Parish, a sand at 1734 ft giving 600 b.d. on a ¼-inch choke. Offshore seismic work reached a peak in 1955, when *ca* 38 crews operated. It is estimated that reconnaissance seismic survey has been done over 80% of the area out to 120 ft water, from Corpus Christi to the mouth of the Mississippi, the total cost of geophysical work being $127,000,000. At the beginning of 1956 leases covered 2,750,000 acres. 410 oil wells, 120 gas wells, and 247 dry holes have been drilled, while 14 major oilfields and 9 major gas fields have been found; 54,000,000 brl of oil and 125 × 10^9 cu. ft. of gas had been

produced. Total expenditure is placed at $1,000,500,000, and 139 wildcats have been drilled. There are 36 tenders, barges, or mobile drilling platforms capable of drilling in 30 ft of water or more. Eventually interest may extend to 150 ft of water or even to 200 ft. Most operators will make little money, but some will be lucky. G. D. H.

1243. South Arkansas sees rosy future. E. J. Murdoch. *Oil Gas J.*, 11.6.56, **54** (58), 174.—Future oil possibilities of S. Arkansas are described. The area has been intensively explored for over 30 years, and although the major fields have been discovered, attention is now centred in smaller areas, where drilling activity has increased considerably during recent years. There may be further discoveries in the Jurassic Smackover limestone, particularly in fault traps, as in N. Louisiana. The Cotton Valley has been found productive on several structures, and has future possibilities in combined structural and stratigraphic traps.

The Lower Cretaceous also has possibilities: the Travis Peak may be found productive in stratigraphic traps and in fault traps along known fault trends, and the Glen Rose and the Paluxy may also be productive in fault traps.

The most favourable zones for Upper Cretaceous oil are thought to be along fault trends, particularly in Miller, Lafayette, and Nevada counties. Other possibilities are areas of low relief along the axes of Upper Cretaceous regional noses.

Future possibilities in older areas of production are also briefly considered. C. A. F.

1244. Guatemala search near. Anon. *Oil Gas J.*, 11.6.56, **54** (58), 105.—Concessions for exploration have been granted in Guatemala, where the geology is largely unknown, although some preliminary work was carried out a few years ago. Centre of interest is the Peten area in N. Guatemala, where the country is flat jungle. Sediments are Tertiary and Cretaceous calcareous beds with a little sandstone and shale. Exploration will be expensive and difficult because of jungle conditions. C. A. F.

1245. Jones makes new Cuban strike. Anon. *Oil Gas J.*, 4.6.56, **54** (57), 77.—I Juanita, 4 miles E. of the small field on the N. coast of Cuba, on test flowed 48 b.d. of 12° oil from 2 zones at *ca* 2000 ft. Further zones are to be tested through a section of limestone with serpentine bands. In the Thomas Bess area 4 wells have been drilled, and development will be on 20-acre spacing. C. A. F.

1246. Jamaican wildcat spudded. Anon. *Oil Gas J.*, 11.6.56, **54** (58), 103.—A wildcat is being drilled in Jamaica *ca* 5 miles S. of Malvern. The well was sited on a structure identified by aerial photographs and confirmed by surface and seismic work. Plans are to drill to 6000 ft. C. A. F.

1247. Oil exploration by Valdebro in Spain. J. Gavala and E. F. Taylor. *World Oil*, 1956, **142** (5), 316.—Exploration and drilling operations by Valdebro in Spain are described. 3 wells have been drilled and a fourth is being drilled since exploration began in 1952. Geological reconnaissance has been completed, and detailed studies are in progress. Gravity and seismic work has also been carried out, and further geophysical surveys are planned. The concessions are in the Ebro Valley (Milagro Concessions) and the Castilfrio area; wells, none of which have had shows, have been drilled in each of these areas. The drilling history of each well is briefly noted, together with stratigraphic data. C. A. F.

1248. Geology of Holland. M. Vigneaux. *Bull. Ass. franç. Tech. Pétrole*, 1956, 221–5.—Much of the low country is covered by Quaternary or Tertiary, which generally increases to the N. or NW., attaining a max of *ca* 1600 m. Carboniferous, Trias, Jurassic, and Cretaceous outcrop in the S. No surface oil indications are known in Holland, but near Bentheim (Germany) there are asphalts.

On the margin of the Brabant massif the Carboniferous is covered by Upper Cretaceous and Tertiary. To the N. is a zone of NW.–SE. faults. In the N. of the country are deep salt domes, and between these 2 regions, stretching from the sea to Germany, are folds. Schoonebeck is on one of the N. folds, which are N. of a Triassic high. Production is mainly from Valanginian sands of high porosity and permeability, but on the crest where this is absent there is a little production from the Purbeck and Portlandian. The structure runs 17 km E.–W. To the W. is Coevorden, where Albian rests on Lias, and gas has been found in the Zechstein. Gas fields are also known at De Wijk, Wanneperveen, and Tubbergen. At De Wijk wet gas occurs in the Permian and Upper Carboniferous. At Rijswick some oil was found in Valanginian–Hauterivian sands at *ca* 1550 m. Upper Barremian production has been found at 1100 m at Delft, and at Pijnacker there is oil in the Valanginian–Hauterivian at 1750 m. G. D. H.

1249. Austrian test hits. Anon. *Oil Gas J.*, 11.6.56, **54** (58), 106.—Puchkirchen 1, *ca* 30 miles E. of Salzburg, has on test produced 250 b.d. of 54° oil. The wildcat is in the Alpine foothills of W. Austria away from the productive Vienna basin. Basement was found at 8500 ft, and pay was a section *ca* 6 ft thick at *ca* 7750 ft. C. A. F.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

1250. Exploration geophysics makes rapid strides. M. B. Dorbin and R. G. van Nostrand. *World Oil*, 1956, **142** (5), 129.—Developments in instruments and techniques in exploration geophysics during the past year are described. The main developments are in magnetic recording, velocity logging, and in high frequency seismic recording; these are now being offered as commercial services. Magnetic recording gives greater flexibility in seismic interpretation, and data is readily stored, but it is an expensive technique. Velocity logs, primarily designed to provide seismic velocity data more conveniently than by well shooting, have been used for correlation, and in some areas are more satisfactory for this purpose than other types of log. The logs have shown that the variations of elastic properties with depth are much more complex than realized hitherto.

Other developments during 1955 include new methods for generating seismic energy and improving signal–noise ratio. C. A. F.

1251. Weight-drop technique—how it's working out. A. D. Waldie. *World Oil*, 1956, **142** (5), 148.—The development of the technique of weight dropping in seismic work during the past 3 years is described. The method was introduced primarily to obtain better seismic records in hard rock areas at a lower cost/profile mile, and this has been generally successful, although the principles are not completely developed. The technique has recently been carried out successfully offshore.

Details of latest results and photograph and diagrams illustrating the equipment, procedure, and results are given. C. A. F.

1252. Some aspects of interpreting seismic data in regions of strong dip. P. Veyretout. *Rev. Inst. franç. Pétrole*, 1956, **11** (3), 353–7.—In areas of marked dip it is necessary to take into account dip components at right angles to the profiles. This has previously been discussed for dips not over *ca* 10°, but the method now presented is applicable to any dip. The cases dealt with are the drawing of a phantom when the cross-section changes in direction, and the linking of a reflection with well data when there is a closed circuit round the well or lines which do not close. G. D. H.

1253. Twenty years of seismic echo technique in Poland. A. Kislow. *Nafta* (*Krakow*), 1955, **11**, 2–5.—Although in the U.S.A. the seismic echo technique was first used on a larger scale in 1929, in Poland 5 more years elapsed before this method was introduced. Between 1934 and 1939 the firm

" Pionier " used American instruments effectively in the Carpathian foothills. Another company, the " Geotechnika," worked in Kujawy prospecting for potash. In 1945 work was restarted very slowly. Now electromagnetic equipment made in Poland has been supplied to State Enterprise for geophysical exploration. The qualified operators are slowly coming forward from colleges. In addition to maps of the Sub-Carpathians completed before 1939 there are now detailed maps of the Krosno region and the Bochnia–Tarnow–Vistula area. The method proves to be accurate and gives echoes from 5000–6000 m from drillings not exceeding 6 m or 800–1200 m from surface explosions. M. S.

1254. New model of echometer. M. Kmiecik. *Nafta (Krakow)*, 1955, **11**, 29–32.—Description with diagrams of a new echometer evolved by the Polish IP, geo-analytical section. M. S.

1255. Gamma-rays as geochemical indicators in geological prospecting. J. J. Glogoczowski. *Nafta (Krakow)*, 1955, **11**, 51–5.—After a summary of the various kinds of radiation and their meaning to a geologist the author describes work done by the Polish IP in 1949–50 using a G.M. counter. Further work in 1950–51 brought improvements in equipment. Plots of radioactivity at various levels from 1 m below to 1·5 m above the ground and at various times of the day are the fruits of this work. On the subject of α-radiation in the soil the author puts forward the theory that radon, which is the source of it, does not come from the crude oil but is swept by CH_4 out of overlaying rocks. CH_4 comes from the crude. M. S.

DRILLING

1256. Exploratory drilling in 1955. F. H. Lahee *et al. Bull. Amer. Ass. Petrol. Geol.*, 1956, **40** (6), 1057.—In accordance with what has now become a well-established custom, this issue of *Bull. Amer. Ass. Petrol. Geol.* is devoted to a review and summary of exploratory drilling in the U.S.A. during the preceding year.

The papers published, apart from the initial summary by the Chairman, which was presented before the Association at Chicago at the April meeting, cover progress in every part of the Continental U.S.A. and also W. and E. Canada and Alaska.

An interesting comparison is made of the progress between 1938 and 1955. Whereas in 1938 only 2638 exploratory holes were drilled with a total of 8,860,484 ft, in 1955, as shown in this report, 14,937 exploratory holes, with a total of 69,173,209 ft, were drilled. Obviously the task of accumulating the data has been greatly augmented. Instead of 22 geologists there are now more than 120 engaged in compiling the statistics.

In the states covered in this review during 1955, a total of 69,173,209 ft was drilled in 14,937 exploratory holes, divided as follows: 3105 producers, 15,953,542 ft; 11,832 dry holes, 53,219,667 ft.

This means that 20·79% of the holes drilled and 23·06% of the footage drilled were successful in 1955. One producer ft was drilled for every 3·34 ft of dry hole. One successful well was drilled for every 3·81 dry holes. The average depth of hole was 4631 ft.

Attention is called to the average depth figures for the various producing classes and for dry holes.

Also listed are the reasons for drilling the new-field wildcats in 1955, by using the best information available from men familiar with such statistics, each in his own state or district. According to these figures, 786 new-field wildcats drilled on technical advice (geology and/or geophysics) were successful, and 5899 were dry; 32 holes, located for non-technical reasons, were producers, and 411 were dry; 100 producers and 876 dry holes were located for reasons unknown. These figures show that 11·7% of the new-field wildcats drilled on technical advice were producers, as contrasted with 7·2% successful in the case of holes located without technical advice. Therefore, in 1955, locations for new-field wildcats based on technical recommendations were 1·6 times as successful as those drilled without such advice. Seismographic methods were largely responsible for 321 producers and 1659 dry holes, among the new-field wildcats.

In W. Canada in 1955, 885 exploratory holes were completed, 246 of these being producers and 639 being dry holes. The producers included 148 oil wells and 98 gas wells. A total of 3,978,114 ft was drilled, 1,165,975 ft in producers and 2,812,139 ft in dry holes. This means that 27·8% of the exploratory holes and 29·3% of the exploratory footage were successful. There were 2·41 ft drilled in dry holes for every ft drilled in producers. For every producer completed 2·59 dry holes were abandoned. The average depth of all the exploratory holes was 4495 ft.

Among the 718 new-field wildcats completed in W. Canada in 1955, 152 were successful and 566 were dry. In other words, new-field wildcatting was 21·2% successful. One producer was drilled for every 3·72 dry holes.

In E. Canada, 131 exploratory holes were drilled, with a total of 219,389 ft. 9 of the 131 holes were successful, 7 as gas wells, and 2 as oil wells. In these producers, 12,723 ft were drilled. Of the 131 holes, 6·87% were successful; 5·81% of the exploratory footage was in successful holes. For every ft drilled in producers, 16·23 ft were drilled in dry holes. The average depth of hole was 1674·7 ft.

In Mexico, which is not covered by a separate paper in the symposium, 114 exploratory wells were drilled in 1955, with a total of 564,712 ft. Of these 114 wells, 46 (28 oil producers and 18 gas producers) were successful. This exploratory programme was 40·3% successful. The average drilled depth of all 114 holes was 4953 ft.

74 of the 114 holes were new-field wildcats which resulted in the discovery of 15 new oil and/or gas fields (20·3% successful).

The Chairman points out that because the summary of the data gathered annually by this committee is the most reliable analysis available of the U.S. industry's exploratory drilling for oil and gas, and because the facts presented in this analysis demonstrate the high degree of risk in exploratory drilling and, therefore, the need and fairness of the 27½% depletion allowance, the work of the committee must go on without interruption in time or omission of any district. E. N. T.

1257. Drilling in the search for oil. F. Leca. *Rev. Inst. franç. Pétrole*, 1956, **11** (1), 22–36.—In 1954 drilling absorbed over 60% ($1,366,241,000) of the U.S.A. exploration costs, and the percentage was similar in France and her territories. The well is all-important.

The rotary drilling equipment is briefly described, and some of the problems involved in selecting the most suitable equipment and well dia are indicated. The question of mobility and the use of slim-hole drilling are discussed, together with rates of penetration, straight holes, jet and diamond bits, and personnel.

France's 60 rotaries drilled *ca* 200 wells, totalling 300,000 m in 1954. In addition, 40,000 m was drilled for geological information. Exploratory wells cost 15,000,000,000 fr and development wells a total of 5,000,000,000 fr. G. D. H.

1258. Science and technique in Soviet Union—some problems of completion of productive formation. N. Y. Udyansky. *Nafta (Krakow)*, 1955, **11**, 63–6.—In *Neft. Khoz.*, Nov 1954, the author deals with difficulties occurring in cases of drill holes to be subjected to hydraulic shooting. Here orthodox methods should be amended by simple expedients. The same journal in its July 1954 issue records drillings to 1600–1700 m done in 19½ days. Mud was pumped at 70–75 l/sec, pressure on the bit reached 33 tons, and 50–70 bits were worn out. M. S.

1259. Air drilling shallow water-flood wells. L. L. Brundred. *Oil Gas J.*, 11.6.56, **54** (58), 144.—The drilling operations in a water-flood development project are described in which air has been used as a circulating medium. Well depths were 400–600 ft, and fast drilling has been possible. Core recovery was

ca 100%, and analyses indicate that saturations are probably more representative of true reservoir conditions than those from cores taken with conventional muds.

26 wells were completed each month during Sept–Nov 1955, one well being completed each working day. Details of the operations, including compressor capacities and cost problems, are given. C. A. F.

1260. Controlling crooked holes. H. M. Rollins. *World Oil*, 1956, **142** (5), 183.—The results are reported of a statistical analysis of crooked-hole data for wells in the Headlee–Warsan trend, W. Texas. Principles of analysis followed were those used by Brantly and Moore in a survey of the Russel field, and the effects on bottom-hole deviation of such factors as bit weight, rate of penetration, and various sizes of drill collars and bottom-hole assemblies are described and indicated on a series of 7 charts. 4 refs. C. A. F.

1261. Engineering appraisal of small diameter hole drilling in soft rock operations. J. H. Faulk. *J. Petrol. Tech.*, 1956, **8**, (4), AIMME Tech. Paper No. 4230, 80–7.—Soft rock formations are defined as corresponding to all the Gulf Coast formations shallower than and frequently including much of the Eocene, and an examination is made of the various factors influencing drilling rate and bit life in various dia holes. It seems that substantially the same daily drilling progress is possible with jet bits in holes of 4½–8¾-inch dia if proper emphasis is placed on obtaining equivalent hydraulic cleaning capacity for the various size bits. However, risks will be somewhat greater in the small size holes. Small holes will permit large savings in h.p. requirements, and give greater rig portability than conventional sizes. When deviation is a serious problem small dia holes cannot compete with the larger holes. 6-inch holes seem assured of success in use, and it is likely that 5½-inch holes will also be a success. Conventional hole evaluation is possible in open holes greater than *ca* 5¾ inches; smaller holes will not at present allow the use of contact logging devices. G. D. H.

1262. Development of services and equipment for small holes. T. A. Huber. *J. Petrol. Tech.*, 1956, **8** (4), 13–16.—Slim hole techniques allow small holes to be drilled and completed with 4½-inch O.D. casing, with savings up to 35% over conventional holes. Although certain calculated risks are taken, these holes can be drilled, fished, logged, completed, produced, and re-worked without undue difficulty. Primary logging can be done in 2-inch holes, cores taken in 2¾-inch holes, and testing performed in 3¾-inch holes. Artificial lift and workover equipment is available for wells with 4-inch casing and 1½-inch tubing, and permanent-type completions can be made through the latter, which will also meet the producing requirements of a large proportion of the wells. Increasing use of fluid injection is reducing the need for conventional artificial lift. Future development may be 4-inch casing with 1½-inch tubing, and in some reservoirs 2¾-inch O.D. casing with or without tubing. If small hole bits are developed to pulverize rather than to chip rock circulating systems may be greatly simplified, and slush pump requirements will be reduced. Most sidewall coring devices are less satisfactory for 5½-inch holes than for larger sizes. G. D. H.

1263. Application of electrical transients to well logging. W. J. Karplus and O. J. M. Smith. *J. Petrol. Tech.*, 1956, **8** (3), 53–5.—A lab study has been made in which a pair of transmitting electrodes and a pair of receiving electrodes mounted as in a sonde traversed the equivalent of a 2-layer medium. Exponentially decaying pulses were fed to the transmitters, while the resulting voltage transient in the receiving electrodes was recorded. The measurements agreed with theoretical predictions. The area under the oscillogram of the voltage received was proportional to the resistivity of the formation, and in the field the integration could be performed electronically and recorded on a strip chart. Additional information could be obtained by recording the wave shape of the received transient at intervals. G. D. H.

1264. Spectral gamma-ray logging. H. R. Brannon and J. S. Osoba. *J. Petrol. Tech.*, 1956, **8** (2), AIMME Tech. Paper No. 4208, 30–5.—Equipment employing a scintillation counter and a pulse-height analyser and photographic recorder has been employed in 5 wells, located in E. Texas, W. Texas, and the Texas Gulf Coast, to obtain γ-ray spectra with a view to detecting the relative amounts of various radioactive elements in the formations. The equipment is described, and some of the limitations of this technique are indicated.

Results for 35 zones are given. These have indicated that γ-ray spectra of subsurface beds can be obtained, and that a practical degree of resolution of the γ-rays can be effected, while in some cases different formations can be distinguished by their characteristic distributions of radioactivity from potassium, thorium, and radium. G. D. H.

1265. Mud. F. Leca. *Rev. Inst. franç. Pétrole*, 1956, **11** (1), 37–41.—When rotary drilling was introduced water was the circulating fluid, but this became charged with fine particles, and a mud was found to have some advantages so long as the visc did not exceed certain limits. The density was also important, but high values could be attained only by adding materials such as barytes. Densities up to 2·3 have been obtained. Filtration of fluid from the mud into the formations gave a filter cake, and the characteristics of this are important. Low filtration values are desirable, and these have been best attained by increasing the degree of dispersion of the suspended clay particles by various additives.

The most effective way of improving the properties of muds has been by adding colloidal clays (bentonites) or organic colloids (starch and cellulose derivatives). The latter are costly, but very effective if the temp does not exceed 140° C. Both groups increase visc.

Muds have a range of particle sizes. They are thixotropic. Lime-base muds have lower visc than those with sodium clays, and are easier to control, but at high temp and pressures they may be altered to calcium silicates. Oil-base and emulsion muds have been used and have advantages.

Muds may be damaged by contaminants from the formations unless they are suitably treated. Mud losses may especially occur through fissures, and sometimes these openings are pressure partings caused by mud pressure. Air emulsion muds have been used for lightness, and air or natural gas has been used as a drilling fluid. G. D. H.

1266. 3-inch ID cyclone removes solids from drilling fluids. W. E. Bergman *et al.* *World Oil*, 1956, **142** (5), 190.—The principles involved in the operation of a 3-inch internal dia cyclone designed for separating solids from drilling mud are described, and results obtained in pilot tests with field and lab muds are presented.

The hydraulic cyclone, like the centrifuge, effects separation by centrifugal force; it consists of a cyl separation chamber into which the feed enters tangentially, a conical gravitation section, a central underflow or sludge discharge and a central overflow.

Results of the tests are tabulated, and these are very encouraging. Further experimental work is required, and the cyclone also has possibilities as a separator of barite as well as drilled solids. C. A. F.

1267. New material for deep well cementing. D. K. Smith. *J. Petrol. Tech.*, 1956, **8** (3), AIMME Tech. Paper No. 4222, 59–64.—Fly ash obtained in burning pulverized coal in steam generating plants is pozzolanic, and has been used with hydrated lime and a chemical activator to give early initial strength for tests designed to determine its suitability for oil-well cementing. When set it has no soluble part which would be leached, or any cpds that should be attacked by brines. At present it is recommended for use at temp over 140° F, and for Gulf Coast conditions it would be suitable for depths of 6000 ft to over 18,000 ft.

Pozzolan–lime slurries weigh 13·5–14·3 lb/g; weighting material can be used to 19 lb/g while retaining adequate pump-

ability and set strength. They do not regress in strength at high temp and are less expensive than either Portland cements or retarded cements used for comparable purposes. The displacement pressures are normally lower than those of other cements, because of the spherical form of the particles, while the low degree of thixotropy of the slurry has advantages. Satisfactory results have been obtained in field tests. The heat evolved is sufficient for detection, while waiting-on-cement times have been comparable with those of other cements. G. D. H.

1268. First results of application of the correct rotary drilling regime. Z. Turkowski. *Bull. Polish Inst. Petrol.*, 1955, **5**, 1–2 (suppl. to *Nafta* (*Krakow*), 1955, **11**).—The author supervised and directed operations in 2 exploratory drillings between June and Dec 1953. Higher progress speeds are recorded with less wear on the bit. 5 bits gave 1650 m drilling without failures. Compared with generally-encountered drilling, progress was more than doubled. M. S.

1269. Current news. Anon. *Nafta* (*Krakow*), 1955, **11**, 74.—Includes details of drilling to 3081 m (record). M. S.

1270. Management of diesel motors on drilling rigs. P. Josse. *Bull. Ass. franç. Tech. Pétrole*, May 1956, 235–52.—After a short discussion of the efficiency of diesel motors, and the factors which affect it, there are sections on speed regulation, constant speed control, synchronization, gear boxes, and fuel consumption. Curves and tables show the interrelationships of various factors, and the causes and signs of some troubles are set out. G. D. H.

PRODUCTION

1271. Testing and completion of wells. A. Houpeurt *et al.* *Rev. Inst. franç. Pétrole*, 1956, **11** (1), 42–54.—The drill-stem tester permits a section of the formations to be isolated and put under a low pressure at the well wall to encourage flow into the well and into the drill pipe on which the tester is run. Fluid in the pipe can then flow or be hoisted to the surface when the appropriate valves are closed. Pressure measurements are also made at the bottom of the tester. The form of the pressure recording is most instructive with regard to the validity of the test and other matters. The best way of getting the static pressure is to have a short flowing period followed by a long shut-in period. Tests may be made on successive intervals through a bed.

When a well is completed the productivity index may be measured. Commonly 3 measurements are made. Flowing and static pressures and outputs are required. The pressure bomb may be on cable or tubing. With proper calibration and use, pressures of the order of 100 kg/cm² may be obtained with an uncertainty not exceeding 70–80 g/cm². To obtain the fluid distribution in the well a pressure profile may be determined. Often the flow is linearly related to the pressure differential, but parabolic relations have been noted for fractured beds where flow may be turbulent. Settled flow is required for good productivity measurements. For transient conditions, measurements of flow of short duration and build-ups on closing-in are obtained. For stable flow, permeability near the well dominates the behaviour; in build-up the permeability of the distant parts is prominent. Comparison of the 2 sets of results may reveal the effects of completion methods.

The flow relationships for gas wells differ from those for oil wells.

The completion details will depend, among other things, on the type of formation and the thickness of the oil column. Stimulation may be attempted, it may be local-scraping, mud acid, surface-active agents, or deep-acidization, shooting, hydraulic fracturing. G. D. H.

1272. Methods for calculating production decline and petroleum reserves. J. J. Zielinski. *Nafta* (*Krakow*), 1955, **11**, 25–9.—The author describes 3 methods. The first, by Czarnocki, worked out in 1921, called the "intensification" curves, whereby from data of production v number of drill holes by extrapolation to zero shows potential before drilling. The second requires the ratio of total yield to the yield in first year from each well, and the average of these gives total possible production from the given oilfield. It is called the "prospective" curve. The third, called the "time–distance" curve, is much more accurate and requires more data, notably (1) free drainage area for each well equal to πx(half the distance between this and the previously drilled producing wells)^2, allowing for geological faults, and (2) the time these previous wells have been producing. A plot of log of initial monthly production v drainage area is a straight line for any given time of production of the nearest existing well. These give a family of curves from which we can evaluate potential production for one well (no previous drilling), *i.e.* the total crude in reservoir as well as future yield from any new well. M. S.

1273. Abbreviated analysis of oil production by integration. A. Mikucki. *Nafta* (*Krakow*), 1955, **11**, 6–9.—To forecast production in a few years' time it is advisable to plot past production on a graph. Although the logarithmic plot does not strike the eye, it is easier to use, since it is a straight-line graph. The total production for several years can be obtained by integration of a curve $C = R.t^n$, but it must be remembered that the integral is higher than actual production. It is best to start integration from year $= 1{\cdot}3 \times n$. If the logarithmic curve breaks, 2 integrations will be necessary, n varies between $\frac{1}{2}$ and 3. This method is most useful in cases of old fields. M. S.

1274. Study of cores and fluids (estimation of reserves). A. Houpeurt *et al.* *Rev. Inst. franç. Pétrole*, 1956, **11** (1), 55–65.—The estimation of reserves is distinct from the measurement of the rate at which a well will produce. Reserves recoverable are determined by the amount of oil in place and the recovery factor. The oil in place is dependent on the thickness and horizontal extent of the oil-bearing zone, and on its porosity and interstitial water content. Cores provide material upon which porosities can be measured, but their fluid content need not be entirely that which was originally present. Interstitial water may be obtained by means of capillary pressure measurements. The limitations of these measurements should be recognized. Electric logs also provide means whereby porosities can be estimated, as well as saturations, and the methods are indicated. In certain circumstances neutron logs can be used for deriving porosities. For thick low-permeability beds the resistivity gradient, together with the densities of the fluids, permits a fair estimate of the permeability to be made. Fluid samples are needed for obtaining values for shrinkage and solubility. Lastly, the recovery factor depends on the producing mechanism, the detailed characteristics of the reservoir, and the way in which the field is handled. In a number of cases of dissolved gas drive it averaged 33%; for water drive it averaged 52%. The choice of a suitable figure depends on many factors. G. D. H.

1275. Acid-soluble cement helps injection well completions. B. Murphy. *World Oil*, 1956, **142** (5), 278.—It is recommended that in well completions acid-soluble cement should be spotted against formation intervals which are potential injection zones; this will permit easy access to the zone. The method consists of adding 40–50% of ground white limestone to the normal cement. The well is then selectively perforated and the zone acidized. Examples are given. 7 refs. C. A. F.

1276. Oil well (bottom) filters. R. Kruczek. *Nafta* (*Krakow*), 1955, **11**, 32–6.—For smooth production of crude it is necessary to have pipes free from sediment. This originates from breakdown of sandstones. Sand in pipes not only interferes with flow but wears out equipment. The author describes filters made in the U.S.S.R. and the U.S.A., also the method of depositing a large quantity of gravel in the cavity vacated by the sandstone. M. S.

1277. Determination of the water-injection programme for the Delhi field by means of the automatic multi-pool analyser. O. L. Patterson, G. Dutton, and H. E. Ellis. *J. Petrol. Tech.*, 1956, **8** (3), AIMME Tech. Pub. No. 4221, 73–9.—The Holt–Bryan reservoir of the Delhi field is 12 miles long, ½–2 miles wide, 2970–3286 ft deep, and had 188 producers completed in the period 1944–48. An E.–W. pressure gradient of *ca* 200 p.s.i. developed before injection began. Calculations indicated that the expected efficient water drive had not developed. When marked pressure gradients exist in a single reservoir, for electrical analyser work it must be treated as several pools, which greatly complicates the necessary trial-and-error procedure. The automatic multi-pool analyser was developed to overcome these difficulties. It represents each pool separately and predicts the behaviour of the whole system. Automatic material balance units are provided for each pool, and these link the production unit and the inter-pool unit, while the latter is tied to the water-drive unit. A curve tracing device permits appropriate values of certain factors derived from P.V.T. data to be fed into the apparatus. The inter-pool network has continuously variable units which represent water compressibility and resistance to flow. The entire history is computed in 0·01 sec, and cyclic repetition permits the behaviour of any element to be displayed on an oscilloscope. Adjustment of controls to get the analyser to match known production behaviour effectively allows for unknowns such as geometry, porosity, permeability, etc. A least-squares computer calculates continuously the sum of the squares of the differences between the measured and analyser pressures for the known history, the best fit being obtained when the meter reading is a minimum. If variation of the elements representing the outer zones of the reservoir have little effect on the known pressure decline curve, the production history is insufficient for reliable performance predictions.

Inferences about the permeabilities and size of the aquifer for the Holt–Bryan pool are discussed. Future performance, taking note of water injection, was predicted on the basis of eliminating the pressure gradient. G. D. H.

1278. Contrast in initial and present application of the term "connate water." L. C. Case. *J. Petrol. Tech.*, 1956, **8** (4), 12.—"Connate water" was originally used to describe sea water in pore spaces sealed in by overlying beds. In recent years, in relation to core analysis, there has been a tendency to use the term as descriptive of water which is not ordinarily mobile.

The term is in any case of doubtful value, because not one case of truly connate water has ever been established.

G. D. H.

1279. Analogue study of water coning. H. I. Meyer and D. F. Searcy. *J. Petrol. Tech.*, 1956, **8** (4), 61–4.—2-dimensional coning was studied by means of flow between 2 vertical parallel glass plates, forming a rectangular area and fed from a reservoir. Glycerine and a visc oil or kerosine were used to simulate oil–water and gas–oil systems via the visc ratios. Variations of plate spacing (permeability), rate of flow, and initial thickness of the 2 fluid zones were used. A reasonable agreement between measured and calculated produced glycerine–oil ratio (R) was obtained by:

$$R = \eta \frac{H_G}{H_o} \frac{t_G}{t_o} \frac{\mu_o}{\mu_G}$$

where t is thickness of liq zone, H is head loss in liq, and μ the visc, with the suffixes G and o being, respectively, glycerine and oil. η approximated to unity. The head loss in the glycerine was taken as:

$$H_G = \left[H_o - h \left(\frac{\rho_G - \rho_o}{\rho_o} \right) \right]$$

ρ being density and h the cone heights.

The experiments suggested that time for a cone to form $\simeq 1{\cdot}1\ A\ \mu_G/(H_G H_o^2 t_G 4b^3 \rho_o)$, where A is cone area, b half plate spacing, and t_G initial glycerine thickness. This gives the right order of magnitude for the time, with max observed errors of 80%.

There was a tendency for the cone to flatten after its initial formation. G. D. H.

1280. Oil and gas production from water-affected reservoirs. J. T. Strzelbicki. *Nafta (Krakow)*, 1956, **11**, 56–9.—The author concerns himself with an effort to extract all available crude from wells which are flooded by seepage from above or from neighbouring water reservoirs. Having constructed an "expanding formation chamber," he has been able to establish that the flow is directed less by gravity than by capillary effects. Several cases are described where, after water was being produced for some time in increasing proportions, the flow of oil was restored. M. S.

1281. Comparison of pressure distributions during depletion of tilted and horizontal aquifers. D. S. Howard and H. H. Rachford. *J. Petrol. Tech.*, 1956, **8** (4), AIMME Tech. Paper No. 4232, 92–8.—It is useful to be able to predict the pressure pattern during pressure decline as a result of extracting fluids from a tilted aquifer. Usually this has been done by solving the equations for a horizontal aquifer, and correcting the patterns obtained for the pressure difference due to the hydrostatic head between the tilted and horizontal aquifers at corresponding points. The errors due to this procedure have been studied by solving numerically the equations for flow in a tilted aquifer, neglecting effects due to temp differences. 3 forms of hydrostatic head correction were investigated. For the case considered the errors due to the approximations were small for all 3 procedures. The error depends on the relative positions of the horizontal and inclined aquifers, and is a max at the producing end, increasing with the amount of fluid extracted. In the example used, the best position for the datum of the horizontal aquifer is between ¼ and ¾ of the way up the inclined aquifer. G. D. H.

1282. Programming reservoir problems on the electric analyser. M. Barrett and W. Rose. *J. Petrol. Tech.*, 1956, **8** (3), 57–9.—Conventional programming concentrates the unit blocks towards the inner radius of the system represented by the analogue by taking blocks of equal radial resistance ($r_i/r_{i-1} = a$). This creates difficulties when the inner radius is small compared with the external radius, requiring many blocks or a large value for the constant. Thus the capacitance and vertical resistance ratios become impossibly large.

The revised programme method depends on $r_i = r_{i-1} n_{i-1}^A + B$, where A is a constant greater than unity, and $B > O$ is frequently less than 0·1 ft. Most single well problems require values of A between 2 and 4. Relationships for radial and vertical fluid resistances and the fluid capacitance of each block can be obtained.

For the study of pressure build-up phenomena it has been found convenient to decide on the number of vertical block units and the number of radial block units, and B is selected to make the first block include only the skin effect. The fluid and electrical values of resistance and capacitance are computed for each mesh point in the model after selecting a proper value for A. Attention is given to the time scaling factor. So far it has been found that the new procedure usually requires larger R_E's than the conventional method, thus reducing the errors due to the lead wires. G. D. H.

1283. Review and analysis of equipment for running electrical cables under pressure. A. C. H. Cooke, C. B. Greer, and F. L. Scott. *J. Petrol. Tech.*, 1956, **8** (2), 10–14.—Field experience on some aspects of permanent-type well completions has shown the need for better means of running conductor cables into wells under pressure. Cable dia of $\frac{1}{4}$–$\frac{7}{16}$ inches are often required. Various seals from the original "line wiper" are described, and a new pack-off technique is reported which allows stranded cables to run at moderate speeds at pressures up to 3000 p.s.i. A further commercial device is described for running cables at pressures up to 6000 p.s.i.

The use of these devices may make it feasible to perforate

additional sections after a well has been brought into production. Tracer logging is facilitated, while radioactivity logs could be made in old wells without disturbing production.
G. D. H.

1284. Elements of fluid mechanics in porous media. A. Houpeurt. *Rev. Inst. franç. Pétrole*, 1956, **11** (3), 328–52.—The 2 problems discussed relate to transient flow in a rectangle and in a circular–radial system. In the latter case the pressure–distance relationship for various times is derived for a single well of low capacity, tapping an anticlinal oil accumulation. The output at various times is also obtained. G. D. H.

1285. Determination of partial pressure maintenance performance by laboratory flow tests. F. F. Craig and T. M. Geffen. *J. Petrol. Tech.*, 1956, **8** (2), AIMME Tech. Paper No. 4207, 42–9.—Lab measurements have indicated that for a certain range of conditions the k_g/k_o characteristics of rocks with sandstone-type pores are the same for soln and external gas drives. The conditions which are favourable in this matter are those likely to obtain in field prediction of performance under partial pressure maintenance. The partial pressure maintenance is obtained by dispersed gas drive.

A means of calculating relative permeability characteristics from partial pressure maintenance flow tests has been developed, and this takes into account the saturation gradient which will exist between injection and producing wells.

The behaviour of a hypothetical reservoir has been computed for several producing programmes, ranging from soln-gas drive to full pressure maintenance. Full pressure maintenance at the original bubble point gives the max recovery, and postponing gas injection or reducing the degree of pressure maintenance gives lower recoveries. The economics of the various programmes are not considered. G. D. H.

1286. Determining gravity drainage characteristics on the centrifuge. J. W. Marx. *J. Petrol. Tech.*, 1956, **8** (4), AIMME Tech. Paper No. 4231, 88–91.—Centrifuging a liq-bearing porous medium increases the drainage rate and minimizes capillary end effects. The physical conditions required for correct scaling of model drainage time with prototype drainage time are set up and discussed. The acceleration is selected so that the mean residual saturation of a model cyl is equal to the residual saturation of an arbitrarily long prototype column drained by earth gravity alone.

In the experiments a Torpedo sandstone cyl 154 cm long and *ca* 5 cm dia was used. The centrifuge samples were of the same rock. Both were first saturated with water and then oil was introduced. The long column was drained by gravity, while the small samples were centrifuged, and oil removal was observed stroboscopically. Correspondence between the gravity drainage and the centrifuge data was as good as the sampling techniques.

In practice, the initial water distribution may not be identical with that of the centrifuge specimen, and there may be dispersed gas, 2 factors which may cause complications. Nevertheless, the centrifuge technique affords the best available means of predicting the gravity drainage curve of an actual reservoir. G. D. H.

1287. Simplified pore size distribution apparatus. H. P. Bucker, M. Felsenthal, and F. R. Conley. *J. Petrol. Tech.*, 1956, **8** (4), 65–6.—The apparatus, at present designed for samples 1-inch dia and 1-inch long, has a steel sample chamber surmounted by a precision bore glass capillary tube. A mercury reservoir is connected to the lower part of the chamber, while the top of the capillary is connected to a manifold which allows of application and measurement of either pressure or vacuum. The vol of the glass tube was carefully determined with mercury. Vacuum is applied when the core is in the sample chamber and mercury admitted until most of the capillary is filled, the height of mercury being measured. The pressure is then raised by stages with corresponding noting of the mercury level until a pressure of 2000 p.s.i. is reached. A pressure–vol correction curve is obtained from a run without a sample. The max correction was under 0·07 cc.
G. D. H.

1288. How plastic-coated walnut shells control loose sands. J. K. Henderson *et al.* *World Oil*, 1956, **142** (5), 271.—The use of plastic-coated walnut shells in well completions involving loose sands is described. The method has been outstandingly successful, with positive sand control in almost all cases.

In the method, ground and graded walnut shells are coated with an unset thermo-setting plastic and then injected into place. After setting, a highly permeable consolidated network results. The technique is as simple as fracturing, and the same service equipment can be used. It can be applied to dual completions, and the effective control of sand may revive production appreciably. Charts and tables show comparative permeabilities of various sand control agents, the effect of differential fluid pressure on the permeability of a consolidated walnut-shell network, and the results of sand control treatments in the Bully Camp field for 10 wells, and in a well from each of 7 other fields. C. A. F.

1289. Some aspects of sand-oil fracturing in long heterogenous sand sections. L. Wilson. *J. Petrol. Tech.*, 1956, **8** (3), 12–16.—The coastal fields of Peru produce 46,256 b.d. from Eocene and Palæocene sandstones which overlie Cretaceous or Pennsylvanian beds, and have dips of 2°–25°. Sand-oil fracturing was introduced in 1953, and has been used in 61 of the 71 pools in one or more wells. To the end of May 1955 319 jobs had been done, and 50% of the treated wells were gun-perforated completions; 42% had perforated liners. Depths ranged 449–7200 ft, and averaged 2970 ft. The gross thickness of pay section was 1200–1400 ft, and averaged 355 ft.

Some wells were new; others as old as 25 years. 20–40 mesh Ottawa sand was used with a locally refined oil of visc 25 cP at 82° F. Injection rates were 3·3–24 brl/min, and pressures 100–4200 p.s.i. Sand concn were 1–3 lb/g. Now the sand–oil mix is preceded by only 50 brl of crude, and the mix is displaced by pumping crude. The wells are fractured via the casing annulus with the tubing hanging. After treatment the wells are shut in for 2 hr generally. When the tubing is lowered some sand is usually found in the bottom of the well.

To the end of May 1955 the additional oil atttributed to fracturing was 1,860,633 brl, and the added rate was 5419 b.d. The percentage success is 70%, and this is based on a pay-off in 3 months. In the Verdun sand, consisting of sandstone lenses in shale, the output averaged 3 b.d./well, and 80% of the treatments succeeded. The Helico sand is hard, shaly, and poorly sorted: 79% of the treatments succeeded, but post-treatment decline was sharp. There was 67% success in the important Parinas sand, and 71% in the Lower Parinas, where nitro-shooting has also been used. 69% success was attained in the Salina sand, which has small sand stringers in a shaly section. Rather spectacular increases were obtained in the 6 Mogollon sand treatments.

The successes appear to be due to opening fractures, eliminating well damage and giving access to new reservoirs. Most successes had a drop in G.O.R. Higher build-ups after success are attributed to new reservoirs. G. D. H.

1290. Goldsmith pressure—maintenance project is living up to its promise. R. J. Enright. *Oil Gas J.*, 18.6.56, **54** (59), 202.—Pressure-maintenance in the San Andres dolomite pay of the Goldsmith field, W. Texas, is described. Water injection commenced in Oct 1954 and is being injected 25 ft below O.W.C. by 31 wells located approx in 2 concentric rings around the S. dome of the structure. During the last 1½ years the reservoir pressure has been stabilized, and at present producing rates there is even pressure increase. Gas is also being injected at *ca* 10,000,000 cu. ft/day into the gas cap through 4 wells at the crest of the structure.

Details of the injection and pumping equipment are given.
C. A. F.

1291. Uniontown hits water flood jackpot. K. E. Barnett and J. R. Vaughan. *World Oil*, 1956, **142** (5), 254.—Water flood operations in the Uniontown Consolidated field, Kentucky, are described, together with the geology and reservoir characteristics. The field is an anticline elongated N.–S. with W. closure against the upthrown side of a normal fault. Production is from the Walterburg sandstone covering *ca* 2000 acres, and the field was discovered in 1942 by Hite Unit 1, which had an initial production of 361 b.d. at plugged back total depth of 1845 ft. Development followed on 10-acre spacing and, with production decline, a pilot injection scheme was introduced in 1951, with expansion of plant facilities and further injection wells in recent years.

The original reservoir characteristics are listed. Primary production was due mainly to soln gas. At present water is being injected into 28 wells at *ca* 140 b.d./well. C. A. F.

1292. Gulf Coast wildcat verifies . . . reservoir-limit test. E. McGhee. *Oil Gas J.*, 18.6.56, **54** (59), 184.—A reservoir-limit (RL) test of a well completed in 1954 in Harris County, Oklahoma, is described. A RL test consists of measuring the rate of change of bottom-hole pressure at a constant producing rate when the well is put on production. With additional data from P.V.T. and other physical properties of the reservoir fluid it is possible to predict the brl of oil or cu. ft. gas connected to the well, the effective D-ft of connected pay, the drainage area and effective drainage radius, and the well completion efficiency. 7 refs. C. A. F.

1293. Evaluation of gas injection in the Emery West pool, West Coyote field, California. S. F. Craddock. *J. Petrol. Tech.*, 1956, **8** (4), 25–30.—Drilling in the Emery West pool, discovered in 1930, was essentially completed in 1943. Gas injection began in 1944 and continued at 10 M.M.c.f/day to 1949; then it was raised to 20 M.M.c.f/day. The pool has faults on the N., S., and E., each being a thrust dipping at 45° to the centre of the pool. It covers 265 acres, and original oil in place was 50×10^6 brl. There is 1200 ft of interbedded shale and sand, the sands being lenticular. Porosity averages 20%, interstitial water 37%, and permeability 70 mD. 38 wells have been drilled on 6-acre spacing; 7 flow, 22 are pumpers, 3 are for gas injection, and 6 are shut in. Oil gravity ranges from 35° on the crest to 29° downflank. Solution gas–oil ratio was 550 cu. ft/brl, and initial pressure 2650 p.s.i. The original visc was 0·64 cP; at present the reservoir viscosity is 1·11 cP. Cumulative oil output is 13,700,000 brl, and the current rate 850 b.d. Present water production is 450 b.d., and the cumulative water output 1,370,000 brl.

Gas is collected at pressures up to 150 p.s.i., and compressed to 1550 p.s.i. for injection via 3 axial wells. Gas appears to enter the producing zone uniformly, and to sweep without serious by-passing. Production is taken from the wells with the lowest gas–oil ratios. It is planned to end injection in 1970. Originally there was solution gas drive. Only 3,500,000 brl of water has entered the reservoir to date.

Without gas injection production of 11,500,000 brl of oil was expected. As a result of gas injection a total of 16,300,000 brl is expected. The cost of the additional recovery is placed at $4,500,000. *Ca* 45% of the extra profit is attributed to additional recovery of natural gasoline and LPG. G. D. H.

OILFIELD DEVELOPMENT

1294. Texas gas . . . where will it come from . . . tomorrow? F. J. Gardner. *Oil Gas J.*, 18.6.56, **54** (59), 180.—Texas holds *ca* 48% of the gas reserves of the U.S.A., and there must be an intensive search for new reserves in order to meet future increased demands. There has been a steady decline in the discovery of new gas reserves in the state in recent years.

Proven gas reserves of Texas are found in relatively few fields: 10% is dissolved gas in oil, 15% is from gas caps, and 75% is non-associated in 22 fields. The most promising areas for future reserves are in the W. Texas Permian basin, the Panhandle, E. Texas, SW. Texas, and the Gulf Coast. Possibilities in each of these areas are described, and maps showing the distribution of present reserves of gas in Texas and relatively unexplored areas are included. C. A. F.

1295. Northeast Butterly pool—case history. R. Butler, S. D. McCloud, and J. Marshall. *J. Petrol. Tech.*, 1956, **8** (2), 23–6.—NE. Butterly was discovered in Dec 1945 when production was obtained at *ca* 4000 ft from the Ordovician Oil Creek (Simpson) sand. It is a small dome with a fault on the SE.; production covers 185 acres, and 11 producers have been drilled. The sand is loose and 150–200 ft thick. Porosity averages 14% and permeability 250 mD. Oil gravity is 13° API, and the bottom-hole pressure is 2500 p.s.i.a. The first wells usually produced 10–12% sand for several months. Commercial bonding resins reduced the sand to 5% or less. The viscous sand-laden oil emulsion is pumped in 3-inch EUE tubing with a 3-inch × 15-ft rod sectional liner pump having a 2¼-inch dia plunger. The pumping rate is 10 strokes/min. 3 g of emulsion breaker/1000 g emulsion is injected at the wellhead before passage to the central treating plant. 20% by vol of blending oil is mixed with the crude before it enters the heaters, and a further 20% is added when the produced oil is drawn from the stock tanks by the pipeline pumps. This is the minimum which will allow the oil to be pumped 5 miles to the refinery.

In 1946–47 with 5 wells each averaging 300 b.d. the total sand production was *ca* 800 cu. ft/day. Now the 4 producing wells are giving 100 cu. ft/week. To April 1955 cumulative oil production was 2,499,950 brl, and now the wells give 314 b.d. Well cumulatives range 7818 to 415,444 brl. The original stock-tank oil is estimated as 15,255,000 brl. Expected ultimate recovery is 19%. Currently typical lifting costs are $0·51/brl. The present wells give 75–80 b.d. oil and 600–700 b.d. salt water. G. D. H.

1296. After Parentis. M. Demargne. *Bull. Ass. franç. Tech. Pétrole*, May 1956, 161–76.—A comparison is made between the French search for and development of oil in 1949, and that in 1956, 2 years after the discovery of Parentis. Then 9 organizations explored 200,000 km², using 40 drills and 4 or 5 seismic outfits. Annual expenditure was 15,000,000,000 fr. and production below 100,000 tonnes. Now 26 organizations explore 1,200,000 km², using 64 drills and 48 seismic outfits; expenditure is expected to be 50,000,000,000 fr; proved reserves in France are 25×10^6 tonnes, and production is 1×10^6 tonnes, while consumption has doubled. Additional facilities have become available. Personnel and equipment have advanced in quality and capacity. In drilling and geophysics the improvement in output has averaged over 11%/year. Under comparable conditions the performances are similar to those of American operators in French territory. In some directions there is much to be done, but some innovations have been made. Private capital is being directed to oil search.

In the next 5 years there should be considerable advances, especially in some directions. Numbers of rigs may rise to 140–150, and seismic outfits to more than 150. Reserves of 120×10^6 tonnes may be found. Efforts will be made to improve operating efficiency, and more use will be made of contractors and central organizations. More skilful coordination of exploratory techniques will be sought, as well as means for directly finding oil as distinct from traps. There will be more foreign operations, joint operations, and spreading of interests. On the investment side more private money is needed, and may come best from bodies which spread the risks. In expansion much of the profits may need to be ploughed back. G. D. H.

1297. The Schoonebeck oilfield. P. Joncquiert. *Bull. Ass. franç. Tech. Pétrole*, 1956, 226–33.—In 1954 Schoonebeck produced 6,500,000 brl of oil. In Aug 1955 pumping gave 2,941 m³/day of oil and 6941 m³ of water. The field, discovered in 1943, began production in 1947, and at the end of Sept 1955, 311 wells had been drilled, 268 being on production

and 7 exhausted. The 17-km fold is 4 km wide. Production is at 600–900 m, from the Valanginian, which is up to 40 m thick, of porosity 30% and permeability several D. The reserves were placed at 200 times 10^6 brl. The oil density is 0·89, and the visc is 180 cP at 30° C. The bubble point is 42 kg/cm². It is hoped to have 50% recovery by using secondary recovery methods. Water is injected after suitable treatment. Fluid pressures are measured at depth electrically, with an accuracy of 0·05% at 200 kg/cm².

Spacing is generally 400 m. Some wells flowed initially. The pumps are in 17 groups, each group having separate separators, heaters, controllers, etc. Water separation involves heating, and electrical and chemical treatment.

The Rijswick field produces *ca* 200 m³/day from a porous clayey sand in the Hauterivian–Valanginian at *ca* 1550 m. 20 m³/day is obtained by pumping from the Upper Barremian at Delft. 6 km ENE. of Rijswick a well at Pijnacker flowed 100 m³/day from the Hauterivian at 1730 m, while at Lier a well has shown promising indications in the Upper Barremian.

Holland has 4 gas accumulations capable of giving 350,000 m³/day. The gas is used for domestic purposes. Some gas has been injected at Schoonebeck. G. D. H.

TRANSPORT AND STORAGE

1298. Ten years' experience in distribution of petroleum products. P. Lipka. *Nafta (Krakow)*, 1955, **11**, 43–6.—In the early post-war days the distribution of petroleum products made the 1945 harvest possible. In the second post-war year consumption equalled that of 1939. During the years 1945–50 the Soviet Union was the principal importer. Due to increasing consumption for agricultural purposes, new stores in rural areas had to be erected. Most of the distribution was done using Soviet lorries and road and rail cars (or tanks). The distributing agency not only supplied the customers' requirements but also suggested most suitable grades, and so contributed to a check on waste and over-consumption. The agency employs qualified inspectors. They still come across wasteful use and give advice in the interest of economy; most users, however, exercise strict control. M. S.

1299. Nuclear power for commercial vessels. K. Maddocks. *Trans. Inst. Mar. Engrs*, 1956, **58** (5), 105.—A survey is made of British and American unclassified work on nuclear power which is applicable to marine propulsion. 5 types of reactor suitable for marine purposes and one for fuel production are described. The gas-cooled reactor is considered most suitable, and a proposed closed-cycle gas turbine plant is analysed. Proposals for the use of nuclear power for the propulsion of specific ships are reviewed, and a comparison is made of the operating costs of a 30,000-ton dw tanker with an oil-fired steam turbine power unit and the cost of operating the same vessel when driven by a nuclear-powered closed cycle-helium turbine. 32 literature refs and discussion. D. K.

1300. Automatic custody transfer. Anon. *Oil Gas J.*, 11.6.56, **54** (58), 110.—Custody-transfer systems are analysed. Methods of vol, temp, gravity, B. S. & W. measurements are discussed, and safe-guards and accessories outlined. Advantages of systems include loss, evaporation loss, and less cash tied up in oil above ground, as there is a reduction in lease tankage. Vol are measured more accurately and accounting simplified. G. A. C.

1301. Metallizing for protection of bulk shipments. H. S. Hammond. *Chem. Engng*, 1956, **63** (6), 278–84.—An account is given of recent experience in the metal-sprayed coating with zinc of cargo spaces in tankers and tank cars to protect their contents from contamination and discoloration. Aluminium, tin, and stainless steel spray coatings have also been used. D. H. A.

1302. Use of heat in the movement of viscous fluids. A. C. Brown. *Fluid Handl.*, 1956, 163–7.—Heating requirements for storage and pumping of fuel oil in a power station are discussed. W. A. M.

1303. Bursting tests on 16-inch o.d. API 5 LX grade X46 line pipe. J. W. Jones. *Fluid Handl.*, 1956, 154–8.—Pipeline for Sui-Karachi was tested to determine yield and bursting pressures. Test specimens were coated with resin, which indicated start of yielding by developing opaque cracks. Specimens of ¼-inch pipe yielded at 1600 and 1750 p.s.i., *i.e.* 370–520 p.s.i. >API test pressure; $\frac{5}{16}$-inch pipe yielded at 2200 p.s.i., 670 p.s.i. >API test pressure. Bursting pressures were 3150 p.s.i. for ¼-inch and 4250 p.s.i. for $\frac{5}{16}$-inch pipe. Welds were satisfactory. W. A. M.

1304. Planning and constructing an offshore pipeline. C. Aldridge. *Oil Gas J.*, 18.6.56, **54** (59), 174.—Basic considerations for inclusion in offshore pipelining include route for best mechanical protection from wave action, and whether trenched, pinned down, or weighted, values of negative buoyancy, currents, coating, marine organisms, drag or push methods, and costs. G. A. C.

1305. Its 80 per cent submarine—and here is how the pipe laying is being done. P. Reed and R. G. Deering. *Oil Gas J.*, 18.6.56, **54** (59), 170.—Operations are described on the 355-mile Muskrat project in S. Louisiana, 285 miles of which is submarine piping. The work is being carried out by Williams Bros. A newly-designed barge is used, with 3 double-jointing racks. G. A. C.

1306. Plastic tape gets full-scale test. P. Reed. *Oil Gas J.*, 25.6.56, **54** (60), 98.—Results of the first full-scale test by American Louisiana Pipe Line Co of plastic taping on 30 miles of 10-inch transmission line show that taping can be carried out steadily at a fast rate, and corrosion resistance is very good. G. A. C.

1307. Power losses in pipeline pumps. G. J. Jennings and L. P. Meade. *Oil Gas J.*, 28.5.56, **54** (56), 136.—A new procedure is described, which is inexpensive, simple, and accurate, whereby temp rise in a pipeline pump can be measured and converted to h.p. loss and efficiency. G. A. C.

1308. More footage—lower construction cost. P. Reed and R. G. Deering. *Oil Gas J.*, 14.5.56, **54** (54), 142.—The new device uses hydraulic and electronic equipment, a movable line-up carriage feeds 2 parallel racks, and automatic pipe rollers start turning when a welder strikes his arc. G. A. C.

1309. Friction factors for flow of non-Newtonian materials in pipelines. R. N. Weltmann. *Industr. Engng Chem.*, 1956, **48**, 386–7.—A generalized friction factor diagram is given from which the friction factors for any material and flow conditions may be obtained, provided that the flow properties of the material are known. Experimental data of other investigators were used to check the validity of the diagram. D. B. S.

1310. Pipe concreted in form. Anon. *Pipe Line News*, 1956, **28** (5), 30–1.—A method for applying a concrete coating by a moulding process is described. This method has the advantage that the coating is uniform. D. B. S.

1311. Soil survey and triangulation problems of offshore pipeline work. C. Aldridge. *Pipe Line News*, 1956, **28** (5), 28.—The methods used in laying an offshore pipeline in Louisiana are described. Water depth and the location of reefs was accomplished by the use of a portable fathometer. The nature of the ocean bottom was investigated by taking cores

at frequent intervals, and later by using a low frequency fathometer which would work down to 35 ft below the ocean floor. D. B. S.

1312. The application of an electronic computing machine to a pipeline problem. D. L. Fayman. *Pipe Line News*, 1956, **28** (5), 40–2.—The use of an electronic computing machine for product scheduling receives particular attention. D. B. S.

1313. Fire protection in pipeline maintenance. W. J. Irwin. *Pipe Line News*, 1956, **28** (5), 50–1.—The procedure and precautions to be taken when a pipeline is opened up for maintenance are described. D. B. S.

1314. Economics of speed fluid drive use in pipeline stations. F. A. Moore. *Pipe Line News*, 1956, **28** (5), 35–9.—A fully automatic unattended pumping station is described in detail. The station handles mainly fuel oil, kerosine, and gasoline, and the use of a fluid drive on the centrifugal pump effects considerable power savings. In this method the speed of the pump is governed by the pressure in the pipeline, and consequently it is effectively linked with other stations on the line so that pressure surges, caused by a change in the liquor being pumped, are reduced to a minimum. D. B. S.

1315. Nomogram for calculation of pipelines at turbulent and laminary flow conditions. G. S. Khovanskii. *Neft. Khoz.*, 1956, (6), 53–6.—A nomogram is given, with an explanation of the basis thereof and method of use. This is applicable to both gases and liq and is designed especially for when the nature of the flow (*i.e.* turbulent or laminar) is not known, as this may be determined from the nomogram. V. B.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1316. The welding of heat-exchanger components. Anon. *Petrol. Times*, 8.6.56, **40** (1535), 441.—A report is given of a symposium and demonstration in London organized by I.C.I., April 1956, on the welding of heat exchanger components in copper alloys. Papers were given on seal welding, sea-water cooled condensers, alternatives to floating head covers, copper alloy for heat exchangers, and choice of a welding system. Demonstrations on metal arc and Aigon arc welding of tube ends and of Aigon-shielded self-adjusting metal arc welding of plate joints. G. A. C.

1317. Heat exchange by direct contact. L. Barbouteau. *Rev. Inst. franç. Pétrole*, 1956, **11**, 358–88.—Previous work on heat exchange between powders and fluids is reviewed, followed by a discussion of the equations governing direct heat exchange for 2 immiscible liq flowing counter-current. Lab tests using kerosine–water are described and, based on the results obtained therefrom, a plant-scale (product flow up to 8000 l/hr) heat exchanger was built, and extensive trials made with kerosine and gas oil (water coolant). Results are given in detail and the design of heat exchangers of this type is considered. V. B.

1318. An alternative approach to the design of 1–2 heat exchangers. E. T. Nelson. *J. Inst. Petrol.*, 1956, **42** (388), 124–7.—An expression for the logarithmic mean temp difference (LMTD) is derived from an alternative method of designing 1–2 heat exchangers, with constant overall H.T.C. Where this coeff is a linear function of temp, the treatment is exact. An example of this is given, and the case is also considered where (1) the overall H.T.C., although constant, does not necessarily vary linearly with temp, and (2) the shell side coeff is the controlling factor. 6 refs. C. B.

1319. Reactor design problem: stable operation. T. E. Corrigan and W. C. Mills. *Chem. Engng*, 1956, **63** (6), 253–6.—The 3 major disadvantages of fluidized-bed reactors, *i.e.* slugging, channelling, and excessive attrition, can be minimized by proper design. For a longitudinal parallel-tube reactor, stable operation is ensured by inserting an optimum-sized orifice in the base of each tube. This is illustrated by the detailed solution of a reactor design problem. D. H. A.

1320. How Sun helped its water problem. H. F. Elkin. *Oil Gas J.*, 28.5.56, **54** (56), 119.—The water supply and waste water disposal system at the Sun Oil Co's refinery at Toledo is described; it provides for comprehensive pollution control of all waste waters, reclamation of spent waters for use within refinery, and a virtually unlimited supply for emergency protection against fire. G. A. C.

1321. Automatic process—stream analysers. T. C. Wherry. *Oil Gas J.*, 28.5.56, **54** (56), 125.—A review is given of units now available for process stream analysers, including differential refractometers, an i.r. analyser, a u.v. type, and one employing a chemical reaction combined with physical measurement to control trace amounts of oxygen. G. A. C.

1322. Vertical cylindrical fluid heating furnaces. Anon. *Engineer, Lond.*, 1956, **201**, 570–1.—"Iso-flow" furnaces are now being built in this country by Birwelco Ltd of Birmingham, under licence from Petro-Chem Development Corpn of New York. They are used for a wide variety of applications outside as well as inside the oil industry. Heat absorption rates are within the range 150,000–150,000,000 B.t.u/hr, with efficiencies up to 87%; oil or gas firing, or a combination of both, is possible. Vertical tubes are arranged around the periphery of a cyl refractory-lined shell, an alloy steel re-radiating cone is suspended from the upper end of the combustion chamber, so that the velocity of the flue gases is increased where their temp is decreasing. All-radiant and radiant-convection types are available, heat release per cu. ft. of combustion space is in the range 10,000–20,000 B.t.u/hr. A. C.

1323. Why limit radiant heat input rates? H. F. Lassner. *Oil Gas J.*, 11.6.56, **54** (58), 133.—Reasons are given for limiting tube wall temp instead of radiant heat input. Some relevant calculations are detailed. G. A. C.

1324. Computers aid in refinery economic planning. R. C. Donovan and R. W. Shrage. *Oil Gas J.*, 28.5.56, **54** (56), 131.—Suggestions are given regarding electric computers, and include the renting of equipment, with a view to purchase if early results are favourable, close co-operation with operations research, and expansion of computer groups. G. A. C.

1325. Texas-Louisiana refiners turn attention to upgrading gasoline products. L. Resen. *Oil Gas J.*, 18.6.56, **54** (59), 160.—A review is given of plants to replace older, less efficient units for production of high octane motor fuel, and includes properties of Esso, Standard Oil Co, Bay Petroleum Co, Gulf Oil Corpn, Republic Oil Refining, and Sinclair. G. A. C.

1326. Stopple set—flow diverted—no shutdown. C. S. Cronan. *Chem. Engng*, 1956, **63** (6), 288–92.—The way in which the stopple device developed by T. D. Williamson Inc enables a main line to be cut into and the flow diverted through a temporary by-pass without shutdown, so that pipelines and processes can be modified without loss of production, is described. The stopple can operate at up to 1700 p.s.i. and 440° F, and is effective on such fluids as crude oil, propane, and steam. D. H. A.

1327. Linear programming solves gasoline refining and blending problems. G. H. Symonds. *Industr. Engng Chem.*, 1956, **48**, 394–401.—It is common practice to determine the cost of manufacturing each of the gasoline components so that the refining and blending operations may be related to the ultimate costs of the finished product. It is shown in detail how the method of linear programming may be applied so that the most economical refining and blending may be carried out. D. B. S.

1328. Take stock of radioactivity. E. G. Fritz. *Petrol. Refin.*, 1956, **35** (5), 201–4.—The uses of radio-isotopes in refining processes are reviewed. These include applications of radioactive tracers, radioactive instruments such as liq level, density, and corrosion gauges, radiography, and activation of chemical reactions by irradiation. D. H. A.

1329. Annual programme in refining industry has been fulfilled. S. Laskowski. *Nafta* (*Krakow*), 1955, **11**, 48.—In this difficult year 3 new installations have been brought on stream, but the shortage of staff checks expansion. In 1954 the Polish refineries were supplied with slightly less naphthenic and paraffinic crude and nearly 50% more asphaltic crude than was anticipated. The total was ¼% above the anticipated quantity, but the production of axle lubricant, diesel oil, and kerosine is 2% below expectations. Cyl oil is 3·4% short whilst all other products, in particular machine oil and transformer oil, are over the expected figure by more than 10%. Total value of products is 4% over the figure planned, efficiency per man rose by 5·8%, and losses fell by 7·7% from 1953 values. Costs fell by 3%. M. S.

1330. Continuous automatic sampling—4. J. H. Berglund. *Oil Gas J.*, 30.4.56, **54** (52), 210.—This part deals with the care and handling of samples from the time they are drawn until delivered to the lab for testing. Sample containers, volatile samples, and identification are matters discussed. G. A. C.

1331. Hydrogen. Anon. *Petrol. Refin.*, 1956, **35** (3), 140–66.—This report on hydrogen presents a wealth of useful data and information useful in process design, mechanical design, and maintenance. R. L. R.

1332. Properties of hydrogen mixtures. F. L. Rubin. *Petrol. Refin.*, 1956, **35** (3), 140–9.—Data on visc, thermal conductivity, specific heat, and density for hydrogen, hydrogen–hydrocarbon mixtures, and some partial data on hydrogen–nitrogen and binary mixtures containing hydrogen. R. L. R.

1333. Compressibility factors of mixtures. W. W. Akers and J. D. Burns. *Petrol. Refin.*, 1956, **35** (3), 154.—The chart uses reduced pressures and temp to determine the compressibility factor of hydrogen, hydrocarbons, and their mixtures. R. L. R.

1334. Compressibility chart for hydrogen. W. F. Hoot. *Petrol. Refin.*, 1956, **35** (3), 150.—Values for the compressibility of hydrogen are given from data by the National Bureau of Standards in graphical form with compressibility factor v pressure in p.s.i.a. with parameters of temp in ° F. R. L. R.

1335. Handling compressible fluids. P. R. des Jardins *et al.* *Chem. Engng*, 1956, **63** (6), 175–238.—The purpose of this symposium by 10 authors is to assist in the understanding and selection of the best compressor for any given purpose. The reasons for compression, the bases for the ultimate choice, and the principles and characteristics of the 6 main types of compressor are described. The various sections deal with compressor application and selection, steam jet ejectors, fans and blowers, centrifugal, axial, and reciprocating compressors, rotary compressors and vacuum pumps, and drivers, controls, and accessories. D. H. A.

DISTILLATION

1336. Progress in crude oil distillation installation. K. Kachlik. *Nafta* (*Krakow*), 1955, **11**, 9–13.—A summary. M. S.

ABSORPTION AND ADSORPTION

1337. Improved cycling—plant operations. C. Resen. *Oil Gas J.*, 11.6.56, **54** (58), 140.—Recent modifications at La Gloria Oil Gas Co's Falfurrias, Texas, cycling plant are described, and include an automatic sampler for a sales gas line, a continuous blowdown system on the cooling tower, utilization of residue-gas pressure in an expanding gas turbine, and the application of corrosion-resistant coatings. G. A. C.

SOLVENT EXTRACTION AND DEWAXING

1338. Determination of the efficiency of a semi-industrial solvent extraction apparatus. The Podbielniak super-contactor. M. Alexandre and P. Gentilini. *Rev. Inst. franç. Pétrole*, 1956, **11**, 389–97.—Apparatus performs counter-current liq–liq extraction by means of a centrifugal contactor (up to 5500 rev/min). Heavy phase enters at centre, light at periphery. Apparatus is described and illustrated, and details are given of tests made on aq extraction of acetic acid from org solvents (the lighter liq being the disperse phase); efficacy up to 12·5 theoretical stages is obtained. Careful control of flow rate and speed of rotation are required. V. B.

1339. Study of a pulsed column for liquid–liquid extractions. Hydrodynamic behaviour. D. Defives, J. Durandet, and Y. L. Gladel. *Rev. Inst. franç. Pétrole*, 1956, **11**, 231–46.—A column 1 m long, 40 mm dia is fitted at 5-cm intervals with sieve-plates (holes 2 mm dia, 23% free area). Studies are made with water (continuous phase)–heptane at max respective flow rates of 10 and 13 litres/hr. Photographs of column in operation are given, together with detailed results; particular study is made of flooding; conditions at which column can operate without flooding can be obtained from curve expressing characteristic speed of droplets as a function of pulse amplitude × frequency. V. B.

1340. Activity of Petroleum Engineers' and Technicians' Association. Anon. *Nafta* (*Krakow*), 1955, **11**, 21.—Conference on dewaxing of oils aiming at high wax recovery took place in Krakow on 9 Dec 1954. M. S.

CRACKING

1341. History of catalytic cracking in the petroleum industry. E. Houdry and A. Joseph. *Bull. Ass. franç. Tech. Pétrole*, 1956, 177–217.—Lecture, in 2 parts; the first (A. J.) dealing with the earlier work of Houdry in France, commencing in 1922 on lignite tar and proceeding to petroleum in 1927, and the second (E. H.) covering Houdry's work in the U.S.A. subsequent to 1930. V. B.

1342. Cat cracking now in two stages. J. D. Heldman, F. Kunreuther, J. A. Marshall, and C. A. Rehbein. *Petrol. Refin.*, 1956, **35** (5), 166–70.—This new technique, which combines the advantages of short contact-time cracking and multiple staging, is a considerable improvement on the single-stage compromise between over- and under-cracking a given feed stock. From pilot-plant trials it was found that a short contact-time riser operating at a high temp, followed by one or more dense-bed reactors at a lower temp, through which the unconverted material from the first stage was fed, gave lower coke and higher gasoline yields. D. H. A.

1343. Two-stage fluid catalytic cracking. J. D. Heldman, J. A. Marshall, and C. A. Rehbein. *Oil Gas J.*, 21.5.56, **54** (55), 230.—The Shell Oil Co's new refinery at Anacortes,

Wash., uses a technique to produce higher gasoline and lower coke yields which involves contacting virgin feed stock with cracking cat in a rising reactor, and then all or part of the unconverted or partially converted gas-oil product is cracked further in a fluid-bed reactor. Wide operating flexibility is obtained by varying conditions in the 2 cracking zones. G. A. C.

1344. Maximum yield of catalytic naphtha. R. C. Davidson, R. S. Shute, and R. B. Secor. *Oil Gas J.*, 4.6.56, **54** (57), 81.—Data from a pilot-plant study using a blend of fresh and recycle gas oils as charged to a commercial cracking unit and converted over equilibrium cat show a slight gain in O.N. with a significant economic advantage for the cat giving a greater yield of cat naphtha. G. A. C.

1345. Reactor design for catalytic reactions—II. T. E. Corrigan and W. C. Mills. *Chem. Engng*, 1956, **63** (5), 203–6.—A qualitative account is given of the problems involved in maintaining uniform gas flow through a parallel-tube fluidized-bed reactor. The importance of inserting a high pressure-drop orifice of exactly the right size is each tube to stabilize the operating conditions is stressed. D. H. A.

1346. Catalytic reactor design problems. I. T. E. Corrigan and W. C. Mills. *Chem. Engng*, 1956, **63** (7), 201–4.—The basic problem in the design of a heterogeneous reactor is to determine the amount of cat required and the reactor size for the desired production capacity and conversion. The 3 basic modes of operation are *iso*thermal, adiabatic and non-*iso*thermal, non-adiabatic. Most commercial reactors are non-*iso*thermal, non-adiabatic. A detailed procedure for the solution of the problem in the simplest case, *i.e.* an *iso*thermal reactor, is given and is illustrated by a worked example. D. H. A.

1347. Making ethylene. 3. Designing a tubular pyrolysis furnace. H. C. Schutt and S. B. Zdonik. *Oil Gas J.*, 14.5.56, **54** (54), 149.—Economical operation in an ethylene pyrolysis furnace depends on high conversion/pass, and olefin concn in the effluent is dependent on the temp and partial pressure of the reactant. The effect of equilibrium approach, desirable temp gradient, pressure pattern, fluid dynamics and heat transfer, and various commercial cracking heaters, such as underdraught, updraught, and sloping-roof furnaces and temp gradient heaters, are discussed, together with water quenching systems. Diagrams are given of tube arrangements and typical temp gradients. G. A. C.

1348. Ultraform to get 100 octane, clear. P. C. White, W. F. Johnston, and W. J. Montgomery. *Petrol. Refin.*, 1956, **35** (5), 171–7.—The American Oil Co's Texas City refinery Ultraformer, designed for 21,200 b.s.d. and the largest in existence, is described. This regenerative platinum reforming process consistently produces a gasoline with 100 research octane. Major difficulties encountered during the early operation of the unit were high reactor-pressure drop, with cat attrition and corrosion due to the presence of H_2S and H_2. These were both successfully overcome. D. H. A.

1349. Unifining-Platforming in one unit. C. F. Gerald. *Petrol. Refin.*, 1956, **35** (5), 216–17.—One of the first units to have a Unifining unit physically combined with a Platforming unit is described. Inspection data are given for typical charge and products. D. H. A.

POLYMERIZATION

1350. Propylene polymerization in a packed reactor. S. R. Bethea and J. H. Karchmer. *Industr. Engng Chem.*, 1956, **48**, 370–7.—Using liq phosphoric acid as a cat, olefin conversions of up to 99% were obtained when a C_3 fraction containing 58 mol % propylene was polymerized. The concurrent downflow packed reactor used is described. The effects of feed rate and pressure, acid strength, temp, and acid circulation rate on the percentage conversion were studied. Reaction rate constants of 3, 10, 19, and 20 vol of olefin/vol of reactor/hr were obtained with the 92, 98, 103, and 109% acid cat respectively. The reaction is relatively insensitive to temp in the 275°–400° F range and has a low temp coeff, as illustrated by an average indicated activation energy of 5000 cal/g mol for the 98 and 109% cat. The mol. wt. of the polymer increased and the O.N. decreased with increasing cat strength. Copper was found to resist the attack of strong phosphoric acid up to 400° F, provided that oxygen was absent and the surface was protected from velocity effects. D. B. S.

ALKYLATION

1351. Two-step approach to alkylation efficiency. G. D. Borthwick, L. V. Durland, and B. J. Pope. *Oil Gas J.*, 4.6.56, **54** (57), 88.—Preventive maintenance procedures and plant tests at Utah Oil Refining Co's Salt Lake City refinery have resulted in more efficient operation. G. A. C.

1352. Characteristics and uses of boron fluoride and its derivatives as catalysts in various hydrocarbon reactions, with particular regard to alkylation and polymerization. A. V. Topcijev and J. M. Pausckin. *Riv. Combust.*, 1956, **10** (5), 319–42.—Results are submitted of experiments in the alkylation of *iso*butane and *iso*pentane with propylene and butylene, and of benzene with propylene. For the alkylation of benzene with propylene the authors give the composition of the alkylbenzenes obtained and discuss the probable reaction mechanism. Boron fluoride base acid cat are characterized by electric conductivity, inherent in the electropolar structure of acids, which serves as a parameter for appraising the variation in the properties of a given type of cat during the reaction. (Authors' summary).

SPECIAL PROCESSES

1353. Oil from coal in South Africa. Anon. *Industr. Chem. Mfr*, 1956, **32**, 111–16.—History of this project over past 30 years is given, culminating in the formation of South African Coal Oil and Gas Corpn Ltd (SASOL) in 1950. Plant is located *ca* 50 miles from Johannesburg, above a low-grade coalfield of 300 million tons (140 years at planned extraction rate) and close to Vaal river for water supply. Coal is first gasified at 350 p.s.i., using steam and oxygen. Latter is consumed at 1800 tons/day, requiring 6 Linde units, and is thus one of world's largest oxygen plants. Synthesis gas ($CO + H_2$) is purified by scrubbing with methyl alcohol at −40° to −60° C ("Rectisol" process). Both fluid cat Kellogg process and fixed-bed cat Ruhrchemie/Lurgi process are used for conversion of synthesis gas to hydrocarbons. Annual output of petrol 55 million I.G., of diesel oil 6·5 million gal. Other products are alcohols, ketones, aromatic solvents, pitch, phenols, waxes, and ammonium sulphate. Expected cost of petrol is 1*s.* 2*d.* gal, *i.e. ca* same as landed cost of imported petrol. Mining cost of coal, however, is very low, 5*s.* short ton (*cf ca* 63*s.* in the U.K.). Photographs of 6 plant units. A. C.

1354. Oil demulsification. M. Simonovic. *Nafta* (*Yugoslavia*), 1956, **7** (5), 137–41.—The causes influencing the creation of oil emulsions and the technical means to prevent their formation are described. Various methods of oil dehydration by means of different techniques are treated separately. The author describes the most up-to-date system as the Howe Baker electric dehydration system, which is installed in the oilfields of W. Germany. (Author's abstract).

METERING AND CONTROL

1355. Use computers for refining problems. J. Sherman. *Petrol. Refin.*, 1956, **35** (5), 139–40.—The way is described in which the Texas Co has applied a high-speed electronic com-

puter to the problems involved in establishing a complete refinery balance, and optimum operating conditions, which are impractical to determine with a desk calculator.
D. H. A.

1356. How to move and meter liquefied gases. C. A. Lee. *Chem. Engng*, 1956, **63** (5), 193–5.—The unloading and metering of a tank car of anhydrous ammonia is taken as an example, but the principles involved apply also to other fluids, such as LPG. Liq in the tank is in equilibrium with the vapour above its surface. The pressure drop through the metering device causes more vapour to be released and introduces an appreciable error into the measurement. 4 methods of overcoming this difficulty, covering both batch and continuous metering, are described. The importance of pressure relief values at appropriate points in piping and hosing is stressed.
D. H. A.

1357. Liquid proportioning. L. Lowy. *Chem. Engng*, 1956, **63** (5), 175–88.—The relative merits of continuous *v* batch proportioning and of meters *v* feeders are discussed. Descriptions of most types of volumetric and gravimetric proportioning devices are included. 2 methods of control, constant rate and flow proportional, are described. The secondary flows may be placed either according to the main flow, or may be directed by a closed control loop.
D. H. A.

1358. GLPC catching on fast. Anon. *Chem. Engng*, 1956, **63** (6), 116–20.—Gas-liquid partition chromatography, because of its wide versatility, is finding many applications in the petroleum and chemical industries, especially in the field of automatic process control. The theory and practice of GLPC are briefly described, together with its advantages over dist and spectrometry. The future possibility of using GLPC as a plant-scale separation tool instead of just for analysis is discussed.
D. H. A.

1359. Better test results in half the time. T. L. Novasad. *Oil Gas J.*, 21.5.56, **54** (55), 181.—An electronic pressure indicator is described which was designed for testing engines and compressors used on natural gas pipelines. Use of the indicator reduces test time more than 50% and gives more reliable results than previous instruments. Diagrams illustrate the operating principle.
G. A. C.

PRODUCTS

CHEMISTRY AND PHYSICS

1360. Determination of vapour–liquid equilibrium data. K. Ridgway. *Industr. Chem. Mfr*, 1956, **32**, 59–67.—A review of advances made since 1948 in the determination of vapour–liq equilibrium data, including stills for partially-miscible systems, and non-recycling types of apparatus for use with materials subject to decomposition. Sources of error which improved stills seek to overcome are enumerated as: contamination by grease from stop cocks, decomposition due to exposed heating coils, fractionation on and flashing from boiler and vapour offtake walls, superheating of liq phase, flashing of low-boiling condensate returning to still, and entrainment. Complex stills described need be resorted to only where greater accuracy is required, not for routine determinations of plant design data. 15 diagrams, 27 refs.
A. C.

1361. Liquid–liquid equilibria of ternary systems consisting of two hydrocarbons and a solvent. Y. L. Gladel and J. Durandet. *Rev. Inst. franç. Pétrole*, 1956, **11**, 488–9.—Further list (*cf* Abs. **1226**, 1955) of 25 new equilibria, published July 1954–Dec 1955. 3 new solvents (nitromethane, sulpholane, benzyl alcohol) appear.
V. B.

1362. Vapour–liquid values made easy. J. F. Voorwijk. *Chem. Engng*, 1956, **63** (5), 201–2.—A new circular nomograph for vapour–liq equilibrium is given which cuts calculation time to an absolute minimum. It is also useful for interrelating weights, volumes, and mol fractions of binary mixtures.
D. H. A.

1363. Applied chemical kinetics. XIV. Chain reactions. J. C. Jungers, J. C. Balacéanu, and G. E. Limido. *Rev. Inst. franç. Pétrole*, 1956, **11**, 599–640 (*cf* Abs. **931**, 1956).

ANALYSIS AND TESTING

1364. Assessment of surface-active "alloyed" oils and emulsions. E. H. Kadmer. *Schweiz. Arch. angew. Wiss.*, 1956, **22**, 185–96.—Tests were carried out with 5 types of lab machine: DS tester (small version of the Timken); Wieland (development of the Almen); 4-ball (Boerlage and Zimmermann procedures); IEB (friction balance developed by Petroleum Research Inst, Hanover); FZG gear tester (*cf* Abs. **969**, 1955). Apparatus is described and illustrated. Method of assessing results on each is discussed, and necessity of weighting (table of factors given) such results so as to obtain a numerical (%) value to give an assessment level comparable with that found on another type of tester. Tests are made with mineral, fatty, and synthetic oils and also with doped mineral oils containing org Cl, S, and S cpds, Cl–S–N additives, Cl–S–P additives, and on doped gear oils. Results are discussed in some detail. It is concluded that guidance as to practical application cannot be obtained from results on any one tester. Results in metal-working tests obtained with cutting oils and emulsions by Production Engineering Research Assoc are cited, and likewise lead to the conclusion that lab tests cannot forecast the results of practical operation.
V. B.

1365. Use of the microscope for determining the extent of regeneration of motor oils. D. D. Ruschev. *Neft. Khoz.*, 1956, (6), 57–8.—Tests on regenerated oils are given, with details of (conventional) recovery treatment; use of a microscope is recommended for detection of particles 3–15 μ which are not shown up by normal tests, and can be present in oils meeting specification for recovered oils.
V. B.

1366. Prediction of flash points of middle distillates. R. M. Butler, G. M. Cooke, G. G. Lukk, and B. G. Jackson. *Industr. Engng Chem.*, 1956, **48**, 808–12.—A theoretical method for predicting the fl. pt. of hydrocarbon mixtures is described. The method can be used for the estimation of the fl. pt. of a blend of hydrocarbons, and a chart for this purpose is given. The standard deviation of a large number of experiments was found to be 2° F. Other uses include the prediction of the fl. pt. of a crude fraction from a standard 15/5 assay curve or a 75/100 dist curve, and also the estimation of the degree of separation obtained in existing refinery fractionators from data on yield and fl. pt.
D. B. S.

1367. Examination of the rheological properties of greases with the aid of the S.O.D. viscometer. J. Briant. *Rev. Inst. franç. Pétrole*, 1956, **11**, 113–33, 247–87.—A theoretical study of the flow of a non-Newtonian liq in a tube is followed by a description of the Standard Oil Development capillary viscometer and its operation. Experimental results (at 25° C) are given on 9 greases (Li/Ca, Al, Ca, Na/Ca) and discussed in detail. An equation is derived for expressing the rheological properties of greases, based on 3 parameters, which can be determined for each grease. Photo-micrographs of the greases are shown; the S.O.D. viscometer does not distinguish between greases of different structure and cannot, *e.g.* in the case of axle grease, be substituted for bench tests; if, how-

ever, structurally different greases of originally similar visc properties are worked (up to 10^5 strokes), then the viscometer does detect differences between them. V. B.

1368. Chromatographic analysis of gases and vapours. C. Rouit. *Rev. Inst. franç. Pétrole*, 1956, **11**, 213–30.—An outline of the principles underlying displacement, elution, and partition chromatography and a description, based on literature survey, of the apparatus used, with special reference to elution chromatography; types of columns and operating conditions are tabulated. A detailed description is given of apparatus, based on work of Janak (*Coll. Czech. Chem. Comm.*, 1954, **19**, 684), for analysis of refinery gases, using CO_2 as carrier. Examples of chromatograms obtained therewith, using various column fillers, are given. Accuracy is better than 2%, and in most cases better than 1%; least accuracy in the case of mixtures containing pentanes. V. B.

1369. Automatic Fischer titration unit for laboratory use. J. F. Brown and W. F. Volume. *Analyst*, 1956, **81**, 308–15.—A detailed description, including photographs, circuit diagram, and list of elec components, of an automatic Fischer apparatus for direct or back titrations. The burette is controlled by a solenoid-operated valve and a dead-stop E.P. (with time-lag) is used. Accuracy equals that of an experienced manual operator. W. A. M.

1370. Equilibrium for C_6's and hydrogen. E. B. Weinberger and C. W. Montgomery. *Petrol. Refin.*, 1956, **35** (5), 141–4.—A digital computer has been used to establish the equilibrium compositions of a system containing C_6 hydrocarbons and hydrogen. The results have useful applications in reforming, isomerization, and dehydrogenation. D. H. A.

1371. Ambiguous or contradictory standards procedure. C. Siniramed and A. Girelli. *Riv. Combust.*, 1955, **10** (5), 343–6.—The article discusses and elucidates certain points which appear ambiguous or contradictory in the procedure specified by the American, British, and Italian standards for determination of the cloud point and pour point of petroleum products.
(Authors' summary).

GAS

1372. Analysis of natural gas. Methods and applications. J. P. Verrien. *Rev. Inst. franç. Pétrole*, 1956, **11**, 641–83.—A lecture, covering: phys–chem equilibrium of gaseous and liq hydrocarbons; sampling; fundamental principles of gas analytical methods; vapour phase chromatography (elution and displacement); mass spectrometry; vapour pressure methods; analysis of non-hydrocarbon constituents; variation of natural gas composition as production proceeds; calculation of compressibility factor. V. B.

1373. Effect of natural gas discoveries on development of European industry. G. E. Limido. *Rev. Inst. franç. Pétrole*, 1956, **11**, 197–212.—A lecture; analyses are given of typical natural gases and also of cracking, coal, and blast furnace gases. Present position in various European countries is outlined and brief statistics are given, including LPG sales. Applications of natural gas in chemical synthesis and metallurgy are discussed; possibilities of the latter are especially stressed. V. B.

1374. Possibilities of using absorption units for recovery of gasoline from natural gas in Poland. J. Girzejovski. *Nafta (Krakow)*, 1955, **11**, 36–9, 60–4.—Polish natural gas contains 92·05% CH_4, 1·3% C_2H_6, 3·0% C_3H_8, 1·8% C_4H_{10}, 1·85% C_5H_{12} plus. Author considers 2 methods available for the recovery of most of the heavier gases. These are (1) absorption in oil, and (2) adsorption on activated carbon. Polish equipment is of the second type, which is cheaper to build but more expensive to run. Author gives details of several designs of type (1) and points out that recovery of propane is 25%, butanes 70%, and "pentanes plus" 90% against values of 32%, 90%, and 100% respectively using activated carbon. As long as the first method will pay for itself it is worth while trying it out. M. S.

1375. Liquid methane. Transport of refrigerated gas under pressure. J. Burns and L. J. Clark. *Fluid Handl.*, 1956, 193–6.—Abs. of paper given to Inst. Gas Eng. Advantages of shipping liquefied CH_4 (from natural gas) under atm pressure in insulated vessels for make-up or replacement of manufactured gas, and problems associated therewith, are considered. Methods of liquefaction are discussed, and particular attention is given to possible designs for sea-going tankers. Boil-off gas (*ca* 0·4%/day) would suffice to propel vessel.
W. A. M.

ENGINE FUELS

1376. Modified residual fuel for gas turbines. B. O. Buckland and D. G. Sanders. *Trans. Amer. Soc. mech. Engrs*, Nov 1955, **77** (8), 1199–209.—The undesirable effects of sodium and calcium salts in residual fuels are stressed, and a method of desalting is described. It is suggested that to the resulting low sodium, low calcium fuel, a water soln of magnesium sulphate be added, in order to inhibit vanadium corrosion. Magnesium is superior to calcium as a vanadium inhibitor, in that it does not cause deposits, at temp below 1650° F. Lead in sufficient quantities in the fuel reduces the effect of the magnesium. The effects of both fuel washing and additive addition on the turbine's efficiency are given. 5 refs.
C. B.

1377. Test house for industrial gas turbines. Anon. *Gas Oil Pwr*, 1956, **51**, 125–7.—This article contains a description of a plant employed to supply gas–air mixtures to gas turbines on test.

Propane is stored in 2 cyl vessels of total capacity 25 tons. Liq propane flows into a steam-heated evaporator, and the vapour is controlled at 150 p.s.i. Air is supplied at high pressure from 2 twin-cyl 2-stage water-cooled compressors, and the mixing is carried out through pneumatically-operated valves which are automatically controlled by variations in the load, and hence in the amount of fuel needed. Various safety devices are incorporated in the system. H. C. E.

1378. Fuels for U.S. Navy gas turbines. H. F. King and H. V. Nutt. *Trans. Amer. Soc. mech. Engrs*, 1956, **78** (1), 185–96.—Engines and fuels to be used in the naval gas turbine programme are briefly described. Extensive research is being carried out on residual fuels, and on ceramic coatings, to prevent corrosion. Cosag fuels (steam–gas turbine fuel) and their development are described. A brief note on the use of residual fuel in base-load gas turbines is included. 5 refs. C. B.

1379. Some aspects of combustion in diesel engines. Does lubricating oil act as catalyst to aid burning? C. H. Bradbury. *Combust. Engng*, 1955, **9** (12), 374–7.—Various aspects of the combustion process in diesel engines are considered, and it is suggested that the lub oil may act, to some extent, catalytically to aid combustion. Various methods of fuel injection are also considered, and methods of measuring engine efficiency are described. One ref. C. B.

1380. Sulphur dew-point corrosion in exhaust gases. R. L. Coit. *Trans. Amer. Soc. mech. Engrs*, 1956, **78** (1), 89–94.—The problems of sulphur dew-point corrosion in both steam and gas turbine power plants are discussed. It is suggested that the use of: (1) corrosion-resistant alloys, *e.g.* Hastelloy C, Carpenter No. 20, or Type 316 stainless steel; (2) low sulphur fuels; (3) the maintenance of surface temp above the acid–water dew-point, could help to minimize this corrosion. It is maintained that none of the coating materials available now is really suitable for low-temp corrosion prevention. 7 refs. C. B.

1381. Possibilities of burning lower-cost diesel fuels. R. McBrian. *Trans. Amer. Soc. mech. Engrs*, Nov 1955, **77** (8), 1387–94.—The research carried out by the Denver and Rio Grande Western Railroad on lower cost fuels and resulting economies is outlined, and the fuels used and their effects on combustion, and lub oil are described. The electron microscope was used to measure particle size, which was found to be a criterion of combustion performance. Lab engine tests are described. It is stressed that the price is not the only factor to be considered and that many problems may arise from the use of cheaper fuels in locomotives. 3 pages of discussion. C. B.

1382. Mechanism of auto-ignition in benzene–air mixtures. A. Beckers and W. J. Levedahl. *Industr. Engng Chem.*, 1956, **48**, 411–12.—The auto-ignition of benzene–air mixtures has been studied in a rapid compression machine and a single cyl, variable C.R. CFR engine. In the former the rate of reaction at differing temp and partial pressures of the reactants was investigated. At 800° K and 20 atm pressure the reaction was approx second order and the apparent activation energy was 11·6 kcal. Benzene–air mixtures were compressed to 40 atm at 900° K in the engine, partial auto-ignition occurred, and the reaction was then immediately quenched during the downstroke of the piston. The products detected during this early stage of reaction were diacetylene, vinylacetylene, acetylene, methanol, formaldehyde, carbon dioxide, and water vapour. Possible mechanisms of this reaction are discussed. D. B. S.

1383. New concept in use of blending stock. F. T. Finnigan and A. W. Percy. *Oil Gas J.*, 25.6.56, **54** (60), 84.—Road performance tests on 7 makes of car show that cat reformate can be blended with an isomerized, light, straight-run gasoline to produce fuels with octane levels of 95, 97·5, and 100 of superior road performance. A minimum of 25–35% aromatics and olefins is necessary to avoid depreciation at low-speed, full-throttle conditions. Higher concn depreciate the road octane values at high speeds and part throttle.

Tables give properties of fuel components and blends. G. A. C.

1384. Estimate gasoline yields from crudes. N. H. Prater. *Petrol. Refin.*, 1956, **35** (5), 236–8.—The method relates the gasoline yield for any end point to the gravity, vapour pressure, and 10% dist point of the crude.

$Y = 0{\cdot}314\,X_A + 0{\cdot}148\,X_B + 0{\cdot}862\,X_C - 0{\cdot}086\,X_D - 24{\cdot}872$

where Y = gasoline yield, % of crude oil; X_A = crude oil gravity, API; X_B = gasoline end point, °F; X_C = crude oil vapour pressure, p.s.i.a.; X_D = ASTM 10% dist point of crude oil, °F. D. H. A.

1385. What will gasoline be like in 1960? J. G. Moxey. *Petrol. Refin.*, 1956, **35** (5), 230–4.—The author, using past trends to back up his extrapolations, predicts that U.S. gasolines will probably have average octane ratings of 93 for regular and 100 for premium in 1960. Front-end volatility will be lighter and tail-end heavier. D. H. A.

LUBRICANTS

1386. Lubricants and lubrication. Anon. *Auto. Engr*, 1956, **46** (7), 262.—Brief review of two papers presented to the SAE Annual Meeting in Jan. G. K. Malone and T. W. Selby of General Motors presented a paper on an investigation into the low temp characteristics of multigrade oils. The other paper discussed is by R. J. Pocock of Ford Motor Co, and this reported a road and lab investigation into the effects of additive oils and oil filters on private car engine wear. D. K.

1387. Studies in lubrication. X. The complete journal bearing with circumferential oil inlet. M. J. Jacobson, A. Charnes, and E. Saibel. *Trans. Amer. Soc. mech. Engrs*, 1955, **77** (8), 1179–83.—The end-lubricated complete journal bearing is studied, and an approx pressure solution for the Reynolds equation is derived and used to obtain expressions for the load-carrying capacity, coeff of friction, axial thrust, and rate of flow of lubricant. The solution is extended to the case of the circumferential oil inlet. 10 refs. C. B.

1388. On the solution of the Reynolds equation for slider-bearing lubrication. IX. The stepped slider with adiabatic lubricant flow. F. Osterle, A. Charnes, and E. Saibel. *Trans. Amer. Soc. mech. Engrs*, 1955, **77** (8), 1185–7.—The load-carrying capacity of the stepped slider bearing with adiabatic lubricant flow is obtained, where visc is treated as a function of temp and pressure, and the variation of density is treated approx. The density-wedge importance is noticed, and a numerical example is given to illustrate the effect on load capacity of different locations of the step. The performance of the stepped slider is compared with that of the flat-inclined plane slider. 5 refs. C. B.

1389. Cleanability and oil-spreading rates. A. L. Bisio, H. B. Linford, and E. B. Saubestre. *Industr. Engng Chem.*, 1956, **48**, 798–801.—The difficulties encountered in removing various oils from metallic surfaces by electrolytic, butyric acid, and soak cleaning processes are discussed. The time required for surface cleaning by any of the above processes decreased with increasing spreading rate of the oil. Oil-spreading rates are thought to be a measure of the bonding existing between the metal surface and the oil, and the mechanism of the spreading is discussed in detail. The use of spreading rate–cleaning time curves eliminates the trial and error method often used and also reduces over-cleaning, which frequently occurs. D. B. S.

1390. Friction in a close-contact system. W. Claypole. *Mech. Engng, N.Y.*, 1956, **78** (6), 529.—Fundamental aspects of the problem of close-contact friction are discussed on a theoretical basis, and experimental evidence is presented in support of inferences drawn. D. K.

1391. Partially fluorinated esters and ethers as temperature-stable liquids. P. D. Faurote, C. M. Henderson, C. M. Murphy, J. G. O'Rear, and H. Ravner. *Industr. Engng Chem.*, 1956, **48**, 445–54.—Liq suitable for use as lubricants and hydraulic fluids at high temp were prepared from aliphatic acids and fluoroalcohols of the general formula $H(CF_2)_nCH_2OH$ and $F(CF_2)_nCH_2OH$. These were prepared by direct esterification, as were isomeric esters of the corresponding fluoracids and aliphatic alcohols. The visc–temp relationships, freezing and pour points, flammabilities, and oxidn and thermal stabilities of the large number of substances prepared are fully discussed.

Dibasic acid esters of fluoroalcohols are resistant to hydrolysis, have lower flammabilities, and have considerably better oxidn stabilities than alkyl diesters or petroleum oils. In general, the esters of the fluoroalcohols are preferred to those of the fluoroacids because of their much greater hydrolytic stabilities. Partially fluorinated esters, with their improved oxidn stability, may be used as high temp lubricants in gas turbines. Other promising applications are discussed. D. B. S.

1392. How viscosity additives function in mineral oils: bibliographical study. T. Salomon. *Rev. Inst. franç. Pétrole*, 1956, **11**, 501–48.—The nature of multigrade oils is explained, with their advantages and disadvantages; action of visc additives is discussed (change in visc–temp curve, effect of shear); various polymers employed are described and pour depressant action of polymers is discussed. It is suggested that valuable data concerning behaviour of visc additives could be obtained from a study of the optical and electrical properties of oils incorporating them, such studies are lacking at present. 95 refs (to May 1955), separate patent survey planned. V. B.

1393. Load capacity and time relations for squeeze films. F. R. Archibald. *Trans. Amer. Soc. mech. Engrs*, 1956, **78** (1), 29–35.—The term "squeeze film" is applied to the film between 2 surfaces having a relative normal velocity, and the

paper studies the transient load capacity, and the time required to change the thickness of various film configurations. A number of practical examples are calculated. An analogy is drawn to the torsion problem, and to that of the flow of visc fluids in prismatical tubes. 8 refs. C. B.

1394. Oil film whirl—an investigation of disturbances due to oil films in journal bearings. B. L. Newkirk and J. F. Lewis. *Trans. Amer. Soc. mech. Engrs*, 1956, **78** (1), 21–7.—Tests were carried out to determine conditions defining a range of stable operation with cyl journal bearings at speeds greater than twice critical speed. 5 bearings and 3 rotors were used, and the tests were run with oil at different visc. The historical background is discussed, and previously-reported findings, which are at variance with the conclusions drawn here, are commented upon. It is concluded that short bearings, with large clearance ratios and moderate unit bearing loads, favour the wide range of stable operation, being stable up to 5 times the critical speed. It is suggested that 2 substantially different phenomena should be recognized. 16 refs and one page of discussion are given. C. B.

1395. Science and technique in Soviet Union—mechanism of action of viscosity-improving additives. E. G. Semenido. *Nafta* (*Krakow*), 1955, **11**, 14–16, 40–2.—Additives are polymers which, according to theories current 10 years ago, tend to coil themselves up when heated. The effect of this and of the structure of these polymers is to retain high visc on heating, thus giving high V.I. Instead of V.I., the author prefers $V_{abs.}$ 50° C/$V_{abs.}$ 100° C ratio. This visc ratio is improved at the expense of the actual visc at 50° C, and oils of low visc respond better when treated with additives. At sub-zero temp visc increases due to crystallization. This is inhibited by some additives, but this aspect is not decisive when we consider visc changes. X-ray and u.v. absorption spectra showed that poly*iso*butylene chains are irregular and non-cryst, liq-like. Any regularity observed is due to external forces. This applies in particular to lower mol. wt. polymers. Their structures and their effect on other hydrocarbons (lub oils) is purely due to blending. M. S.

1396. Pressure-operated cylinder lubricator. Anon. *Gas Oil Pwr*, 1956, **51**, 78.—Describes a new method of lubricating cyl of diesel engines which, it is claimed, leads to reduced wear of piston rings and cyl liner. Lub oil is delivered to a point in the cyl wall just below the piston crown at t.d.c. just before combustion commences. The lubricator is operated by hydraulic pressure from the high-pressure fuel pump. Results of tests are not given. H. C. E.

BITUMEN, ASPHALT, AND TAR

1397. Five years use of Lacq bitumen in road work. J. Lefol. *Bull. Ass. franç. Tech. Pétrole*, 1956, 253–9.—Since 1950 *ca* 170,000 tons of Lacq bitumen and 360,000 tons cutback have been used in France on the roads. Analysis of 80/100 grade is given. V. B.

1398. Extension of GR-S polymers with a California asphalt. R. E. Isley, F. C. Bruce, and E. E. Stahly. *Industr. Engng Chem.*, 1956, **48**, 458–64.—Californian asphalt oils were used alone and in mixtures with asphaltene-free petroleum oil as extenders for 5 GR-S polymers of varying styrene content and Mooney visc. The asphaltenes present acted as an adsorbent for the petroleum oils, and so allowed the use of larger amounts of extender (up to 35%), and at the same time gave improved processibility, reinforcement, elongation, and flex life. The optimum amount of asphaltenes varied from 5 to 15%, dependent on the polymer employed. D. B. S.

1399. Asphalt oxidation with agitation. A. R. Rescorla, W. E. Forney, A. R. Blakey, and M. J. Frino. *Industr. Engng Chem.*, 1956, **48**, 378–80.—Asphalt required for roofing and coating applications must have a lower pen and higher soft. pt. than paving asphalts. These requirements may be met by the oxidn of residual asphalts, but this process is often tedious; the time may be reduced, however, by carrying out the process in a mechanical agitator. Experiments were carried out in a lab scale unit, 12-inches in dia and 21 inches high, and the effects of impeller speed, temp, and air rate on the time to reach a soft. pt. of 220° F were studied and compared to the results without agitation. At a temp of 475°–500° F and a speed of 880 rev/min, the time of oxidn for several commercial asphalts was reduced from between 13 and 14 hr to between 2 and 3.

The oxygen content of the exit gas increased slowly during a run, and this suggested that additional efficiency could be realized by better dispersion using a larger impeller.

D. B. S.

1400. Lives of highway surfaces—half century trends. G. D. Gronberg and N. E. Blosser. *Pub. Rds, Wash.*, 1956, **29** (2), 17–24.—Data is collated for 25 states and Puerto Rico for the period from 1 Jan 1900 to 1 Jan 1953, on the length of service life of roads before replacement, and appropriate action taken when necessary. 8 main surface coatings are compared, their life expectancy being illustrated diagrammatically; this varies from 5·2 years for lower surface types to 25·5 years for the higher grades. S. L. C.

SPECIAL HYDROCARBON PRODUCTS

1401. Liquid–vapour equilibrium relations in the ethane–*cyclo*hexane system. W. B. Kay and R. E. Albert. *Industr. Engng Chem.*, 1956, **48**, 422–6.—The vapour–liq equilibrium ratios ($K = y, x$) of ethane in paraffin hydrocarbons are significantly different from those in benzene. The effect of mol structure of the solvents on the K ratio has been investigated by determining the P–V–T–x relations of an intermediate system, ethane–*cyclo*hexane.

The vapour pressure curves of pure *cyclo*hexane and the pressure–temp and density–temp curves of 6 different mixtures of ethane and *cyclo*hexane have been determined at pressures between 100 and 1330 lb/sq. in. and, by suitable cross-plots of the P–T–x space, the K ratios of ethane in *cyclo*hexane, and vice versa, calculated.

For a given temp and pressure below the critical temp of ethane, the K ratios for ethane in *cyclo*hexane are intermediate in value between those for ethane in paraffinic and in aromatic liq. D. B. S.

1402. Laboratory coking of heavy residues from domestic oils. F. Sef. *Nafta* (*Yugoslavia*), 1956, **7** (5), 129–37.—The Yugoslav aluminium industry requires relatively large quantities of electrode coke. This study has been undertaken in order to examine the possibility of producing petroleum coke for this purpose from vacuum residues of domestic oils. Lacking a pilot plant, the coking tests have been carried out on a lab scale. Larger lab equipment has been constructed capable of giving a sufficient quantity of products for the determination of their qualities and for tests concerning their further treatment. The cat cracking of liq dist and eventual necessity of reducing the content of sulphur in petroleum coke have been taken into consideration. The equipment and the process of the continuous charging into the preliminary-heated oven are based on the well-known industrial procedure with Knowles ovens. Yields of coke, liq products, and gas have been examined, and on the whole their qualities have been fixed. The yields of coke are somewhat larger, owing to the diversity of vacuum residues, proportional to the Conradson carbon. Yields of the coke from 19·4, 27·9, and 27·2% vacuum residues of the domestic oils from Mramor Brdo, Klostar, and Bunjani amount to 23·0–22·2, 20·1–18·8, and 20·6–19·8% wt at a calcination temp of 500°–790° C on the bottom of the oven. Yields of liq products amount to 68·6–68·1, 68·7–67·1, and

63·5–62·8% wt, and those of gas amount to 11·4–13·1, 10·7–13·1, and 13·5–14·7% wt for the above-mentioned residues and calcination temp. The content of coke volatile combustible matter decreases and varies in all residues approx from 7 to 2% with the rise of the calcination temp at a set interval. The content of ash in coke varies from 1·5 to 2%, as raw oils have not been desalted before the preparation of vacuum residues. The content of sulphur in coke obtained from all examined residues does not vary essentially with the change of the calcination temp. It amounts to 1·9–2·1%. The quality of liq products is not influenced by the calcination temp. According to the ASTM dist on the average *ca* 21% of the liq product distils at 200° C and *ca* 61% between 200° and 371·1° C. The average mol. wt. of gas in all residues decreases with the increase of the calcination temp from 23 to 19. With the described equipment and procedure it is possible to prepare from the vacuum residues of domestic oils a petroleum coke nearly corresponding to the specifications for the electrode coke used in the aluminium industry. The content of ash will be lowered by the usual refinery procedure of desalting raw oils before dist. With the commercial coking procedure, which was followed in this work, it is possible to lower the content of coke volatile combustible matter below 2%, but a slightly different distribution of sulphur in products is to be expected. Besides, a probable preparation of a mixture of domestic oils with one richer in sulphur will give vacuum residues which will produce coke containing a proportionately larger amount of sulphur. For these reasons, when producing electrode coke for the aluminium industry, it is indispensable to take into account the necessity of removing certain quantities of sulphur. (Author's abstract).

DERIVED CHEMICAL PRODUCTS

1403. Direct oxidation of ethylene to ethylene oxide. M. Pellegrin. *Rev. Inst. franç. Pétrole*, 1956, **11**, 490–500.—World production (1955) of C_2H_4O is *ca* $5 \cdot 10^5$ tons (uses indicated), new plants tend to direct oxidn process rather than older chlorhydrin method. Reaction (Ag cat, 220°–350° C, 5–25 atm, H_2O extn of product) is discussed (inflammability limits of reacting mixture, selectivity, yield, cat type, and support); a typical flow sheet is shown and the effect of operating conditions is considered; fluid cat techniques do not appear suitable for this process. V. B.

1404. Thermal conductivity of some organic liquids. O. B. Cecil and R. H. Murch. *Industr. Engng Chem.*, 1956, **48**, 437–40.—The thermal conductivities of several organic liq have been determined using a hot-wire type of apparatus. Average % deviation from the mean of duplicate measurements was ±0·4%. A convenient method for calculating thermal conductivities of binary and ternary mixtures is given. D. B. S.

1405. Vapour–liquid equilibrium in acetone–benzene–ethylene dichloride system. L. N. Canjar, E. C. Horni, Jr., and R. R. Rothfus. *Industr. Engng Chem.*, 1956, **48**, 427–30.—The ternary and 3 binary systems have been studied at atm pressure in an Othmer-type still. The binary data have been tested for thermodynamic consistency and found satisfactory, although there are some inconsistencies in the benzene–acetone system. This observation is probably due to a chemical change in the acetone as it is recycled through the still. The data show good agreement with previous workers. D. B. S.

COAL, SHALE, AND PEAT

1406. Coal—chemical and other process uses. H. J. Rose and R. A. Glen. *Industr. Engng Chem.*, 1956, **48**, 351–9.—The non-fuel uses of coal include those in which: (1) coal is converted into other products by processes such as gasification, hydrogenation, oxidn, hydrolysis, extraction, etc.; (2) coal or coke is used as a source of carbon for the reduction of ores and non-metals, and for the conversion of oxides to carbides or to chlorides; (3) coal is used primarily for some particular property, *i.e.* manufacture of activated carbon, cation-exchange materials, artificial graphite, and moulding materials.

The types of reaction involved in these uses, the unit requirements of raw materials, the yields of primary products, and the present and future consumption of coal, coke, and electric power are discussed. The uses of residual products from the above processes and of materials associated with coal in the ground are outlined. D. B. S.

1407. Specific gravity–oil yield relationships of two Colorado oil-shale cores. J. W. Smith. *Industr. Engng Chem.*, 1956, **48**, 441–4.—Algebraic equations have been developed for the specific gravity–oil yield relationships of 2 Colorado oil-shale cores. These equations, which were of parabolic form, showed a max deviation of ±2·5% of the true value in 95% of the cases. The uses of the equations are discussed. D. B. S.

MISCELLANEOUS PRODUCTS

1408. Extender oils for non-staining rubber. R. L. Provost, E. L. Borg, T. L. Paige, W. W. White, and L. H. Howland. *Industr. Engng Chem.*, 1956, **48**, 455–7.—The causes for the staining and discoloration in white or light synthetic rubbers when exposed to light were investigated and traced to the extender oils employed. Aromatic oils were found to produce considerable staining, which could be reduced by the removal of asphaltenes and nitrogen bases. Solvent refined oils, low in aromatics and free from asphaltenes, showed a remarkable degree of freedom from staining and discoloration. The tensile strength and abrasion resistance of the masterbatches prepared with these oils were equivalent to those of naphthenic oil-extended rubber vulcanizates. D. B. S.

1409. Effect of partially fluorinated diesters on elastomers. F. X. Cunningham, R. C. Taylor, and L. B. Lockhart, Jr. *Industr. Engng Chem.*, 1956, **48**, 465–6.—Measurements were made of the vol swelling of several different rubber stocks in both di-*n*-amyl glutarate and its partially fluorinated analog bis (ψ-amyl) glutarate the diester of glutaric acid, and $H(CF_2)_4CH_2OH$.

The fluorinated diesters had little effect on the basic elastomeric materials, and in fact extracted some plasticizer from the compounded and cured stock. The results indicated that the useful temp range of many rubber formulations in a partially fluorinated diester may depend mainly on the properties of the base elastomer itself. It may, however, be possible to increase the max operating temp by compounding the diester with a rubber stock having good resistance to high temp ageing. D. B. S.

1410. Butadiene, synthetic rubber pace expansion. L. Resen. *Oil Gas J.*, 18.6.56, **54** (59), 163.—4 new plants are noted for production of 343,000 tons of butadiene and 232,000 tons of synthetic rubber. The plants are situated at Houston, Odessa, and Orange, Tenn. Other plants at New Orleans, Baton Rouge, Sterlington, and Freeport, for production of allyl chloride, polyethylene, nitroparaffin, and glycerine, etc. G. A. C.

CORROSION

1411. Design for minimum corrosion. B. W. Neumaier and C. M. Schillmoller. *Petrol. Refin.*, 1956, **35** (5), 146–9.—The method is described by which the Richfield Oil Corpn planned its cat reformer for minimum corrosion. Metallurgical selection was based on the max corrosion rates by H_2S and H_2 attack. Their method of continuous corrosion evaluation and control for the plant is revealed. D. H. A.

1412. An application of cathodic protection to the inside of a tank. J. H. Graves. *Corrosion*, 1956, **12** (5), 254–6t.—A 10,000-brl bolted tank was found to have developed active internal corrosion within an 8-year period. The tank was then coated on inside bottom and 2 ft up on the shell with a coal tar product, and steam coils were installed. After 12 years' additional service it was found that 4 leaks had developed in the tank. After repair, 4 × 9-lb magnesium anodes were installed and 6 inches of water placed in the tank to serve as electrolyte. Current outputs were restricted, and the 9-lb anodes were ultimately replaced by 17-lb anodes. It is calculated that 4 × 17-lb anodes would last 3–4 years.
W. G. R.

1413. Battle catalytic reformer corrosion. R. W. Neumaier and C. M. Schilmoller. *Oil Gas J.*, 28.5.56, **54** (56), 121.—Metallurgical selections for various parts of the reformer and hydrodesulphurizer units of Richfield Oil Corpn are based on plotted anticipated max corrosion rates. G. A. C.

1414. High temperature hydrogen sulphide corrosion in Thermofor catalytic reformers. E. B. Backensto, R. D. Dew, R. W. Manuel, and J. W. Sjoberg. *Corrosion*, 1956, **12** (5), 235–44t.—Corrosion tests conducted in 2 Thermofor cat reformers have shown that carbon and low chrome steels will not resist H_2S attack under the high temp conditions of the process. The commercial tests confirm lab results which indicated that only 18/8 stainless steel and higher alloys show good resistance to this type of corrosion.

Reducing the H_2S concn and the use of aluminium-coated steels have also been successful in combating this type of corrosion. W. G. R.

1415. Collection and correlation of high temperature hydrogen sulphide corrosion data. G. Sorell and W. B. Hoyt. *Corrosion*, 1956, **12** (5), 213–34t.—Corrosion by gas mixtures containing H_2S at elevated temp is reviewed, with particular emphasis on the types of environment present in cat reforming and desulphurizing plants. The nature and mechanism of H_2S corrosion is discussed. It is shown that corrosion depends primarily on temp and H_2S partial pressure.

The authors state that the corrosion resistance of carbon steel and chrome–moly alloy steels is approx equal in the environments studied; the 12 Cr stainless steels offer slight improvement, but their performance is erratic. The 18/8 stainless steels possess excellent resistance except under the most severe service conditions.

Aluminium coatings are said to be practically immune to H_2S attack, but there is insufficient experience to appraise their permanence in prolonged service. W. G. R.

1416. Iron in oil technique as a corrosion control criterion. R. G. Rydell and W. M. Rodewald. *Corrosion*, 1956, **12** (6), 271–6t.—The authors point out the need for short-term control to supplement present long-term studies in the evaluation of the corrosion protection afforded by inhibitors in producing oil wells. Evaluation studies were made on 94 sour wells, and it was found that a break point value of 55 p.p.m. iron in the oil existed between economically corrosive and non-corrosive wells. The dividing line between wells which are corrosive and those under good corrosion control may vary, depending on the area. W. G. R.

1417. Status report on oilfield structural plastics. NACE Technical Unit Committee T-1J. *Corrosion*, 1956, **12** (6), 69–72.—Mandrel-wound glass–plastic pipe has a tendency to develop slow, weeping type leaks at pressures far below those which would ordinarily cause failure by rupture. It was thought that poor glass–resin bond might be responsible for such leaks. Edgewise porosity tests for pipe and flat laminates were therefore devised. An account is given of the procedure followed in making these tests and of the results obtained. W. G. R.

1418. Recent Navy experience with saran and vinyl coatings. W. W. Cranmer. *Corrosion*, 1956, **12** (5), 245–6t.—The U.S. Navy has made use, in submarine tanks and in gasoline cargo tanks of tankers, of a vinylidene chloride–acrylonitrile copolymer lining. It was found that its use was justified in cases where a heavy duty coating resistant to fuels and salt water was necessary and short periods of moderately high temp were to be encountered. In addition to reducing corrosion, it was found that use of the coating simplified the cleaning of tanks.

It was found that the vinyl system was sufficiently superior to the old plastic paints in corrosion resistance to justify its use. It was also found that the vinyls gave a performance at least equal to the average obtained with hot plastic. In view of the fact that the film was still tough and adherent after 2 years' service, it was concluded that touch-up rather than complete removal and renewal was feasible. W. G. R.

1419. The selection of materials for some petroleum refinery applications. J. F. Mason, Jr. *Corrosion*, 1956, **12** (5), 199–206t.—Extensive tabulated data with accompanying discussions are devoted to quantitative information on the performance of various ferrous and non-ferrous alloys in refinery service. The alloys include Monel, Admiralty brass, cupronickel, and austenitic stainless steels. W. G. R

1420. Chlorosulphonated polyethylene (Hypalon) as a construction material for chemical equipment. R. McFarland, Jr. *Corrosion*, 1956, **12** (5), 197–8t.—The introduction of chlorine into the polyethylene polymer results in a reduction in the crystallinity and stiffness to the point where the product is exceptionally tough but workable. This product has oil and chemical resistance greatly in excess of the resistance inherent in unmodified polyethylene.

The sulphur dioxide reaction introduces sulphonyl groups which can be used to vulcanize the polymer with a metallic oxide-organic acid system and an accelerator to give a tough, high-strength elastomeric vulcanizate.

The properties and possible uses of Hypalon are outlined.
W. G. R.

1421. Report on application techniques, physical properties and chemical resistance of chlorinated rubber coatings. NACE Technical Unit Committee T-6A. *Corrosion*, 1956, **12** (4), 191–5t.—Chlorinated rubber can be formulated into coatings which exhibit excellent resistance to most acids, alkalis, salts, mineral oils, moisture, and fungus growth. Resistance to oxidizing agents is generally good, but is dependent on temp and concn of the oxidizing agents.

Recommendations are made regarding the use of chlorinated rubber coatings in various media for both a temp of 120° F and for room temp (70° F).

The physical properties are also given, and the application of such coatings is discussed. W. G. R.

1422. Report on epoxy resins. NACE Technical Unit Committee T-6A. *Corrosion*, 1956, **12** (4), 187-90t.—The properties of baked epoxy resin coatings are discussed. Recommendations are made regarding the use of epoxy resins in various media, and their application is briefly outlined.
W. G. R.

1423. Report on rigid polyvinyl chloride. NACE Technical Unit Committee T-6A. *Corrosion*, 1956, **12** (4), 183–6t.—This report outlines the properties and uses of rigid PVC, in addition to discussing its fabrication. W. G. R.

ENGINES AND AUTOMOTIVE EQUIPMENT

1424. Engine research. Anon. *Auto. Engr*, 1956, **46** (7), 254.—Aspects of the work carried out in the laboratories of Ricardo & Co Engineers (1927) Ltd are described. They include diesel engine development, high-speed sampling valve, fuel-line pressure measuring unit, blowing rig, engine operation of highly leaded fuels, cold starting rig, heat flow, injector temp measurement, residual fuels, E6 and E16 engines, and the Alcock viscous flow meter. D. K.

1425. Yes, supercharging by tuning engine exhaust and intake is possible. C. S. Kenworthy. *Oil Gas J.*, 21.5.56, **54** (55), 148.—Experimental work is described on a 4-cyl, 4-cycle 14¼-inch × 16-inch gas engine rated at 760 h.p. at 277 rev/min to supercharge it by tuning the exhaust and intake piping. The method, which has limitations is practical where the engine operates at constant speed and can be brought up to full speed at a light load, as in the case of an a.c. generator. G. A. C.

1426. Automobile free-piston engine. F. D. Robinson. *Nature, Lond.*, 1956, **177**, 914.—A comparison is made of the free-piston and the diesel engines in respect of thermodynamic efficiency, mechanical design, installation, fuel requirements, etc.

The power–weight ratio of the free-piston engine is between that of the diesel and the gas turbine; fuel consumption is much better than that of the gas turbine, and at full load is almost equal to that of the diesel engine. H. C. E.

1427. Study of some characteristics of detonating combustion in a controlled ignition engine. K. Karout. *Rev. Inst. franç. Pétrole*, 1956, **11**, 398–435.—Examination is made, on the CFR engine, of 3 physical characteristics of detonation: rate of pressure increase during detonation; vibrations of gas mass due to detonation; detonation delay, *i.e.* interval between spark and appearance of detonation. The apparatus is described in detail, with circuit diagrams. Tests with 4 synthetic binary mixtures (all of the same F_1 O.N.), which were assessed by: standard detonation intensity (dp/dt); standard detonation intensity (detonation vibrations); incipient detonation, by ignition advance being varied at fixed C.R.; incipient detonation, by varying C.R. at fixed ignition setting. Ratings of fuels differ, with no simple relation between the methods, hence rating of fuel at a given C.R. does not indicate best fuel for a higher C.R. Tests with commercial fuels show that spread between Road and F_1 O.N. is due to: difference in methods of rating (fixed C.R. with variable ignition for Road, reverse for F_1); difference in nature of detonation and its level (faint audible knock for Road, intense standard knock for F_1); rate of energy release, characteristic of the particular fuel (shown by the detonation delay). V. B.

1428. Fuel and maintenance economics of the *Auris*. Anon. *Gas Oil Pwr*, 1956, **51**, 84.—Describes the good condition of the high-pressure part of the power turbine after burning 500 tons of boiler fuel (1200–1500 sec Red I 100° F). H. C. E.

1429. Developing a production gas turbine. Anon. *Gas Oil Pwr*, 1956, **51**, 102–4.—Suitable fuels for the Ruston TA gas turbine are sewage gas, producer gas, gas oil, etc. Creosote pitch has also been used on tests extending to over 1000 hr, although for successful operation the soda content must not exceed a max value. For this fuel a refractory-lined combustion chamber has been developed to reduce heat transfer to the metal walls and to assist in burning the readily-formed carbon particles.

Tests with residual fuel and pulverized peat have also been made, but neither fuel is yet considered suitable for commercial operation.

A further development is the construction of turbines which can simultaneously burn 2 fuels, *e.g.* gas oil and natural gas, in varying proportions. H. C. E.

1430. Waste heat recovery from oil engines and industrial gas turbines. L. Walter. *Combust. Engng*, 1955, **9** (12), 364–7.—Various examples of both diesel and gas turbine waste heat recovery systems are described, and the advantages pertaining to them are stressed. C. B.

1431. Automotive ignition system works on gas-compressor engines. A. E. Hinton. *Oil Gas J.*, 21.5.56, **54** (55), 166.—Texas Gas Transmission Corpn uses standard components and has converted them with low-cost reliable ignition systems. Details of design and construction are given. G. A. C.

SAFETY PRECAUTIONS

1432. Precautions against explosions due to static electricity when filling tanks with petroleum products. F. N. Lak'yanov. *Neft. Khoz.*, 1956, (5), 59–63.—Results of tests on earthed road cars during filling with gasoline show that, at atm humidity of 48%, a potential of up to 1100 V can exist between surface of liq and earth; when humidity rises to 72% potential is negligible. Curves given relating surface potential (for petroleum products and other liq) to height of liq in vessel, showing that explosion risk is at max towards end of filling. Hence pumping rate should be reduced when tank is 75% full. As well as being earthed, tanks should be bonded to filling hose; risk is reduced by filling several tanks simultaneously. V. B.

MISCELLANEOUS

1433. Shifting centre of petroleum production. G. B. Moody. *J. Petrol. Tech.*, 1956, **8** (3), 19–22.—Rumania led in recorded crude oil output in 1857–59, the U.S.A. was the largest producer yearly for 1860–97, and regained the lead in 1902 from the U.S.S.R. The U.S.A. has given over half the world's output yearly since 1860, except in 1898–1902 and 1953–54; for 1907–47 it exceeded 60%. Canada, the U.S.S.R., Venezuela, Iraq, Kuwait, and Saudi Arabia all had their peak outputs in 1954. California, Kansas, Louisiana, New Mexico, Ohio, Oklahoma, Pennsylvania, Texas, and Wyoming are the most productive states in the U.S.A. Texas had a peak in 1953, and has been in the lead for 27 years. Kern River, Spindletop, and E. Texas are among fields which in their time have been outstanding.

At the end of 1954 the average output/well in the Middle East was 1660 b.d. (the U.S. average was 6·2 b.d.). The U.S. has given 59·6% of the world cumulative production, Venezuela 9·7%, U.S.S.R. 9·4%, Mexico 3·3%, Iran 3%, Saudi Arabia 2·3%, Kuwait 1·7%, and Iraq 1·4%; California, Oklahoma, and Texas had given 11·9%, 8·3%, and 21·1%, respectively.

World reserves were estimated as $161{\cdot}1 \times 10^9$ brl at the end of 1954, the U.S.A. having 18·3% and the Middle East 62% of the total; the corresponding figures at the end of 1945

were 31·4% and 37·8%. California, Louisiana, and Texas had, respectively, 2·4%, 1·8%, and 9·3% of the world reserves at the end of 1954.

California has had 5 peaks of discovery, each set off by a particular method of search for oil.

Although the centre of known reserves has shifted to the Middle East, the centre of production may not move in that direction for a considerable number of years, and for a variety of reasons the U.S.A. oil supply seems adequate for many years to come. G. D. H.

1434. Essential factors in the future development of the oil industry. Anon. *Petrol. Times*, 6.7.56, **60** (1537), 575.—The 8 papers presented at the IP Summer Meeting are abstracted and include: world energy outlook, outlook of atomic energy, oil demand outlook, oil resources in the next half-century, changing pattern of world oil movements, recent developments in oil refining techniques, oil's future as a source of chemicals, and financial factors in oil development. G. A. C.

1435. The petroleum industry and the D.S.I.R. Anon. *Petrol. Times*, 22.6.56, **60** (1536), 505.—Points of interest to the petroleum industry are given from the Annual Report of the D.S.I.R. to Sept 1955, and includes the study of action of corrosion inhibitors using radioactive tracers, selection of foams for base injection in fire fighting, control of Fischer–Tropsch reactions, and study of factors responsible for changes in flow properties of residual oils during storage. G. A. C.

1436. Fuel in India. M. N. Saha. *Nature, Lond.*, 1956, **177**, 923.—The various fuels in use in India—coal, petroleum, hydro-electricity, cattle dung, and wood—are compared on a calorific basis. In 1952 the indigenous production of petroleum was $0{\cdot}2 \times 10^6$ tons and $3{\cdot}3 \times 10^6$ tons was imported; it is shown that petroleum products contributed $<5\%$ to the total fuel economy of India. H. C. E.

1437. Fourth annual review of the fundamentals of chemical engineering. Various. *Industr. Engng Chem.*, 1956, **48**, 562–684.—This review contains sections on: heterogenous catalysis; rate theory and homogeneous reactions; mol transport properties of fluids; diffusion and oxidn of metals; colloids and surface behaviour; computers, mathematics, statistics, and automation; fluid dynamics; heat transfer; mass transfer; and thermodynamics. D. B. S.

1438. Petroleum observers at the Geneva conference. R. Montarnal and D. Defives. *Rev. Inst. franç. Pétrole*, 1956, **11**, 699–727.—Survey of ground covered by Aug 1955 Geneva conference on atomic energy, main divisions being: pile principles; reactor design; production of materials used (fuel, sheath, moderator, coolant, control elements); application of radio-isotopes and radiation; use as energy source, and dangers. V. B.

1439. Activities of the Association of Petroleum Engineers and Technicians. R. Wolwowicz. *Nafta* (*Krakow*), 1955, **11**, 69–71.—Lectures and educational activities have the following objectives: (1) filling gaps in individual education; (2) bringing up-to-date the operators' knowledge of technology; (3) consolidation of effort to raise living standards; (4) teaching of economy in operation; (5) spreading of standards of safety; (6) spreading of standards of efficiency; (7) political education. Since 1950 the number of lectures has risen 4 times and attendance nearly 3 times. Other efforts are educational short courses for operators and foremen, and convening of conferences. M. S.

1440. Technical and scientific meetings of 1955 concerned with the utilization of thermal energy. H. Guénoche *et al.* *Rev. Inst. franç. Pétrole*, 1956, **11**, 728–40.—Report on the following: lectures on organization of, and research undertaken by CRC (Paris, May; London, June); joint conference on combustion (Boston, June; London, Oct); French flame radiation committee (Paris, Dec); 2nd combustion symposium (AGARD) (Liège, Dec). V. B.

1441. Inventiveness in petroleum industry. R. Szynagel. *Nafta* (*Krakow*), 1955, **11**, 71–2.—In 1954 over 300 inventions were applied saving approx £1100 each. 8 major ones are listed. M. S.

1442. What has been shown by the party-economic conference in Oilfield Industry District Gorlice. W. Olszówski. *Nafta* (*Krakow*), 1955, **11**, 67.—Savings of the order of £800,000/district/year can easily be reached. M. S.

1443. On the eve of the New Year. S. Schindler. *Nafta* (*Krakow*), 1955, **11**, 17–18.—Before the war the Polish petroleum industry was primitive. This led to loss of formation pressure. The German occupation made things worse. During the 10 years since the war the Polish petroleum industry has been expanded, reconstructed, re-equipped, and electrified. Now there are Polish equipment factories and numerous welfare centres in existence. As a result productivity rises. Deepest drilling in the Sanok region reached 3083 m without mishap. Various plan figures were reached before the end of 1954, and production costs are falling. Prospects are good for the petroleum industry to repay its debt to national economy. M. S.

1444. Current news. Anon. *Nafta* (*Krakow*), 1955, **11**, 23–4.—100 kg of iodine/month from Silesian brines bearing 144 mg I_2/litre by means of the pilot plant designed by W. Chojec is the aim of the Polish IP staff. Production plan for 1954 was completed ahead of time. Great savings were made during the year, and a new tower has been brought on stream in one of the refineries. The Drilling and Producing Organization has been split into 7 regional units. M. S.

1445. Radio-isotopes in the petroleum industry. I. Industrial control and applications. M. Grenon. *Rev. Inst. franç. Pétrole*, 1956, **11**, 684–95.—Brief descriptions are given of radio-isotope application to: well logging, level location in drilling, well cementation, crude recovery (use of tracer in flooding water), acidizing, pipeline cleaning, pipeline transfers, level measurement in refineries, wall thickness measurement, cat tracing, fluid flow through porous media, flow in dist columns, wear of road surfacings, mechanical wear, lubrication problems, cleansing power of detergents. **II. Radio-elements in the chemistry of the petroleum industry.** P. Lévêque, *ibid.*, 696–8.—Brief discussion of application of radioactive isotopes in: analysis (C/H ratio, S, TEL); as tracers in chemical reactions; for inducing chemical changes (*e.g.* polymerization of C_2H_4, chlorination of C_6H_6). V. B.

1446. Report on synthetic detergents. Anon. *Petrol. Times*, 6.7.56, **60** (1537), 585.—The final report of the Committee on Synthetic Detergents on the effects of the increasing use of these materials is reviewed and recommendations made. G. A. C.

1447. Unseen, unheard, and unsmelled. D. H. Stormont. *Oil Gas J.*, 14.5.56, **54** (54), 157.—A control programme for abating refinery nuisance is given, and pollution control organization and pollution control are discussed. Items include elimination of stack smoking, steam plume, odours, foul waste waters, and sound suppression. G. A. C.

1448. Atmospheric pollution by automobile exhaust gases. G. Leidi and A. Ragno. *Riv. Combust.*, 1956, **10** (5), 347–68.—After brief reference to the various types of contamination which may be present in the atmosphere and to their different sources, the authors deal with the part played by automobile exhaust gases in this problem, especially in towns and cities. In particular, the large quantity of this exhaust is stressed, and the conditions promoting its discharge from petrol and diesel engines are discussed. A review is then offered of the products given off by complete and incomplete combustion, and the latter is blamed for the formation of the harmful cpds present in exhaust gases. The article concludes by mentioning the possibility of restricting these exhausts.

(Authors' summary).

BOOK REVIEWS

Petroleum Production Engineering—Oilfield Development. Lester Charles Uren. London: McGraw-Hill, 4th Edn., 1956. Pp. xii + 792. 90*s*.

Professor Uren of the University of California has re-written and expanded the contents of the first of his three well-known companion volumes on Petroleum Engineering in order to cover the many important advances and improvements in methods and equipment which have taken place since the publication of the third edition ten years ago.

This book deals essentially with the properties and occurrence of oil in nature, drilling practices, and the logging and completion of oil wells.

The second of the three companion volumes, "Oilfield Exploitation," now in its third edition, deals with the winning of oil from the field which has been developed by drilling, and the third, "Oilfield Economics," as its name implies, covers the basic principles of the economics and business administration which apply to the petroleum producing industry.

As the author states in his preface, the ten years which have elapsed since the publication of the third volume of "Oilfield Development" have been marked by important advances in methods and equipment, which have necessitated expansion and sub-division of several chapters, and the abandonment of the chapter on exploration methods included in the last edition. It may be agreed that no great loss results from the excision of this chapter.

It is interesting to glance through the earlier editions of this book, which was first published in 1924, as they demonstrate the soundness of the author's approach to his subject, and his clear conceptions regarding the important and the unimportant. These attributes have made it possible for him to bring his writings up to date and still maintain their original framework.

Professor Uren is to be congratulated on the way he continues to achieve his objective to provide a textbook which will satisfy the requirements of university students and at the same time be simple enough to be read with understanding by laymen interested in the oil industry.

The practising engineer and technologist is apt to take for granted the continuous advances which occur in the realm of oilfield development. This is possibly because there have been few outstanding changes in the basic methods of drilling and completion of oil wells. Any such tendency will be negatived by a glance at Fig. 27 on p. 96, which shows the increasing depths attained in drilling for petroleum. In 1909 the world's deepest well was 5000 ft; while in 1953 a depth record of 21,482 ft was achieved.

In detail, special mention may be made of the excellent chapters on well logging, well surveying methods, and well completion methods which cover, *inter alia*, all the latest developments in such practices as acidizing, gravel packing, formation fracturing, gun perforating, and electrical logging. These, and the new selected bibliographies to be found at the end of each chapter, by themselves justify the publication of this new fourth edition and, at the same time, the body of the work takes care of up-to-date drilling procedure with the clarity and brevity which have always been typical of the author's publications. E. C. S.

Petroleum Refining with Chemicals. V. A. Kalichevsky and K. A. Kobe. Amsterdam, London, New York: Elsevier Publishing Co., 1956. Pp. xi + 780. 95*s*.

It is not unreasonable to view this book as a successor to "Chemical Refining of Petroleum," of which the first-named of the present writers was a co-author, and which appeared in two editions (1933, 1942), although no reference to this is made in the preface. Reversal of the title is presumably not accidental but deliberate, so as to enable physical methods (*e.g.* solvent refining) to be legitimately included, as being refining with chemicals rather than chemical refining.

The approach throughout is essentially practical, as may be judged from the authors' remark, "the refiner is not interested in the chemical composition of products but in their quality and ability to meet specifications." The opening chapter deals with treatment applicable to crude oil, including the breaking of crude oil emulsions, and also briefly covers the composition and classification of crudes. There then follows a chapter on the evaluation of petroleum products, in which the principlal laboratory tests are discussed and their significance explained, a section of considerable value in a book such as this and which is to be welcomed. A realistic attitude to the subject of product tests is shown by the authors' view that "specifications should be limited to a few significant tests" and that "tests used for controlling operation of refinery units must be short."

The chapters dealing with actual refining procedures begin, as might be expected, with one devoted to acid refining, and naturally almost exclusively concerned with the effect of sulphuric acid, although mention is made of the other acids whose use has, at one time or another, been proposed. Subsequent chapters deal with the use of alkalis, refining with adsorbents, desulphurizing and sweetening, solvent refining (including azeotropic and extractive distillations), de-asphalting, and dewaxing.

The term "refining" has been interpreted in a wide sense as including the application of additives, and the last two chapters are devoted to this topic, one dealing with additives for non-viscous petroleum fractions, *i.e.* in effect engine fuels, although brief mention is made of additives for fuel oils. An omission noted is the absence, in the list of cetane number improvers, of *iso*propyl nitrate, which is being increasingly used, at least in this country, for this purpose.

The final chapter, the longest in the book (which may perhaps be taken as indicating contemporary trends in refining) is concerned with lubricating oil additives. These are classified into seven groups, treated in separate sections, which include tables showing the numerous types of substances which have been patented in each group.

The book incorporates 172 tables (excluding the appendix) and 49 figures; relatively few flow sheets are given, as the work is addressed more to those concerned with the chemistry rather than the operating lay-out of a process. One of the principal features of the book is the wealth of references which is provided (767 in the case of the chapter on acid refining alone). It may be added that the author throughout refers to the "Inst. Petroleum Tech.," even when dealing with references subsequent to 1938. Also, the 1937 (second) World Petroleum Congress is frequently referred to as the third. In certain cases more modern sources could have been selected, for example, when discussing the refining of transformer oil with liquid sulphur dioxide the latest reference is to a publication dating from 1936, although more recent work on this topic is available. (The 1949 reference (248) given on p. 344 as dealing with transformer and turbine oils is misleading, as this paper only concerns light distillates up to gas oil.)

In the discussion of the use of solvent extracts mention might have been made of the various applications, *e.g.* as drying oil diluents, which were developed for these materials during the last war.

A few mistakes have been noted. The first of the temperature coefficients for refractive index given on p. 46 is ten times too big; "of" instead of "or" in the penultimate line of p. 82; "quality" in place of "quantity" in the heading of the right-hand column on p. 84; Table 154 appears to be erroneously headed, it presumably refers to lubricating oil fractions obtained from various types of crude and not, as indicated, to the crude oils themselves.

However, in a book of this size and scope a few omissions and minor errors are inevitable amongst the enormous amount of information which has been included.

There is no doubt that this volume will be of great value to the student and to refinery personnel, both in itself and as a guide to further reading in the original literature. The research worker will also find it of help, in its comprehensive listing of the numerous refining methods that have been proposed, as to what has already been done on a particular problem. In fact, one of the criticisms that may be made is that, although all refining agents appear to be included, insufficient selectivity has sometimes been shown in indicating which are, in practice, widely applied and which should be relegated to the category of "paper patents."

A short appendix gives certain useful tables, such as viscosity and colour conversions; the physical properties of a number of pure compounds are also tabulated. In the case of these last data it is a little surprising to find all relevant temperatures given on the Fahrenheit scale, as in fact appears to be the rule practically throughout the book. This seems a regrettable retrograde step, requiring considerable mental arithmetic by readers accustomed to the more normal (for scientific purposes at least) Centigrade scale. If, as apparently appears to be the case, the use of ° F is necessary for American readers (and do even these really expect to see "$n_D^{68°F}$"?), then in a work printed in Europe, and two out of three of whose publishing centres are European, it could be expected that the relatively small amount of extra editorial work necessary to insert both temperatures might have been done, at least for the more fundamental figures such as b.p., m.p., and reaction temperatures. The use of ° F alone could then be confined to cases, such as viscosity index calculations, for which that scale has become generally accepted.

The book is extremely well indexed, there being author, subject, chemicals, and patents indexes, totalling in all nearly 100 pages. An indication, at the bottom of each alternate page of text, of the page at which the references to that chapter are given, is a helpful time-saving device.

V. B.

Bitumen in Hydraulic Engineering. W. F. van Asbeck. London: Shell Petroleum Co. Ltd., 1955. Pp. 154.

Although bitumen has been an established constructional material for roads and building purposes for many years and its waterproofing qualities have been long recognized, it is only during the last 20 years that its use has been extended widely to hydraulic works. This book gives a brief account of the physical properties of bitumen and of the various types of asphalt, and outlines the general principles underlying the use of these materials in hydraulic engineering. Many examples are given, with full details of the types of work carried out in different countries, most of them being of major importance. Coastal protection schemes in both this country and in Holland have employed bitumen in varied and interesting forms; it has been used in irrigation projects in arid regions; it is used in reservoirs, in dams, and in diversion canals that form essential parts of hydro-electric plants and in the construction and maintenance of breakwaters and navigable channels and canals.

The book is a comprehensive reference book that should be most useful for both engineers and technicians faced with problems in hydraulic engineering. It is well illustrated with photographs and diagrams, gives details of asphaltic compositions that have been successfully used, gives tables of information required for the design of canals, and summarizes the outstanding and authoritative literature on the subject.

The description of the properties of bitumen and the methods of testing is necessarily brief, and although the book might appear unbalanced if these matters were fully discussed, yet an explanation and a better understanding of the phenomena of adhesion and impermeability would have added much to its value; in view of the purpose of the book one would have expected to find special mention of these phenomena.

A. R. L.

The Development of American Petroleum Pipe Lines. A Study in Private Enterprise and Public Policy 1862–1906. Arthur Menzies Johnson. Ithaca, N.Y.: Cornell University Press for American Historican Association. London: Geoffrey Cumberlege, 1956. Pp. viii + 307. 36*s*.

This volume, with seven illustrations, is one of a number of unusual works published by the American Historical Association, financed by the Albert J. Beveridge Memorial Fund. The author is Assistant Professor in the Department of English History and Government in the U.S. Naval Academy, and he had, with the aid of collaborators, access to masses of records, public documents, manuscripts, press comments, and letters, tracing from 1906 onwards the troubled events which attended the introduction of pipelines for transport of petroleum. A vivid description is given of the early struggles to replace road, rail, and water transport of petroleum by pipelines in the Eastern States, where oil was first produced in quantity. Not only was labour embittered through loss of occupation by those engaged in haulage, but also those who engaged in the manufacture of casks, cisterns, and other receptacles. Rights of way were opposed by those liable to suffer real or imaginary losses from the innovation, or encouraged by bribes to oppose transit over land they occupied. Although the advantage of gathering lines on the oilfields and the transmission of crude oil to refinery centres was generally recognized, suspicion of unfair treatment by major interests controlling purchase and movement of oil caused popular discontent.

From very early days the progressive and successful operations of the Rockefeller Standard oil combination caused unrest and recrimination, although by its agency markets were made available that would have long eluded less opulent or enterprising corporations. Nine chapters divided into an equal number of periods are chronologically devoted to accounts of the quarrels, fights, litigation, and Congressional actions that ensued as the result of conflicts of interest, in practically all of which Standard Oil prominently figures.

The evolution of pipelines enforced on the owners provision for storage at strategic points, and acceptance of oil necessarily involved charges for a variety of risks that were not always appreciated by the many small producers. Besides the actual cost of collection, transmission, and measurement of oil, allowance had to be made for such factors as evaporation, leakage losses, water contamination and impurities, fire, and other hazards. During periods of over-production, when gluts of flush production from newly discovered oilfields depressed prices, the proprietors of pipelines became targets of attack through their inability or unwillingness to accept or store unwanted oil. As more and more dependence was placed upon pipeline transmission of oil from the fields to the refineries, a popular demand for regulations and public control was voiced. State action designed to alleviate the distress of struggling producers and curb the activities of those operating pipelines led to public enquiries into their conduct and affinities, and these divulged the employment of tactics considered detrimental to public interest. By various subterfuges adopted to remove or minimize competition, opposition was stifled by secret rebates, allowances, deductions, and drawbacks; and essential wayleaves along or across railways were obtained only by compensating advantages.

A fascinating story is unfolded of the almost incessant fights and lawsuits between opposing interests associated with the production, transportation, refining, and sale of petroleum. As the most enterprising and successful, the Standard Oil Company became the object of most criticism and abuse, and the narration of the virulent attacks on this so-called octopus by aggrieved or disappointed opponents

disclosed most of those features which today characterize the attacks on combinations of capital. Directed by some of the most competent business men in the U.S.A., and defended in lawsuits and enquiries by the most eloquent legal talent of the day, the Standard successfully weathered many onslaughts against its early expansion. Not until the discovery of oil in the Mid-Continent and in California did it become possible to enact Inter-State legislation and procure Federal action.

The Inter-State Common Laws presented an opportunity for the Federal Government to apply common-carrier conditions to trunk pipelines. Every imaginable and disingenuous argument seems to have been employed by the opposing parties in efforts to discredit or appraise actions confused by bitter political controversies and distorted press statements and propaganda. Allegations of abuse of power and the extermination of competition by questionable methods were countered by denials of illegal acts, and submissions that the resulting benefits derived from co-ordination greatly outweighed any discomfiture occasioned by some whose possessions were incorporated. A favourite argument of those opposing the Standard Oil Trust was that even if difficult to prove that coercive measures had been employed, it nevertheless constituted a potential economic power that ought to be curtailed by legislation.

In 1890 J. D. Rockefeller did apparently break years of self-imposed and dignified silence when endeavours were being made to apply the Anti-Trust laws to the Standard Trust. In an interview with a reporter of the *New York World* he prefaced his remarks by saying "my practice throughout life has been to mind my own business, and I have found that if a man does that in an efficient manner he supplies himself with a sufficiently absorbing occupation. All I ask for the business I represent is unbiased judgment of its aims and merits and fair criticism of its acts." He then submitted that without its existence as a combination of capital amounting to $90,000,000, of which $30,000,000 was invested in pipelines, the oil industry could never have reached its existing state of prosperity. Although dissolution of the Trust was enforced in 1892, and hailed as a great anti-monopolist victory, the *Yale Review* and other influential papers considered that its enforcement in no way checked the process of combination, and predicted that the dissolution would not change appreciably the common management of the Standard Oil group of companies, as indeed has proved to be the case.

As an historical record of events which gradually led to the introduction of acceptable conditions regulating the use of pipelines, this well-written book can be recommended to all interested in such a subject. Its value is, however, enhanced by the comments of many great industrialists and others whose familiar names are honoured household words in oil industry parlance. A. B. T.

Flow of Gases through Porous Media. P. C. Carman. London: Butterworths Scientific Publications, 1956. Pp. ix + 182. 30*s*.

Many papers have been written on the subject of flow of gases in and through porous media, and the author has succeeded in producing a well-connected account of the present state of knowledge of this complex subject. He has obviously put much thought into presenting the work in a logical sequence.

The subject is approached from the viewpoint of the Kozeny theory. It is unavoidable that the coverage of so extensive a field precludes detailed discussion of all aspects of the work. For example, the petroleum technologist will be disappointed with the over-brief treatment of the extreme cases of flow in very fine and very large pores. The flow or diffusion of gases in systems where the pores are of molecular dimensions is of fundamental importance in catalyst studies, and flow in large pores is of no less importance in the study of "packed columns" and fluidized beds.

Two especially worthwhile additions, not implied by the title, are the review of recent work on the surface diffusion and capillary flow of adsorbable gases in fine pored systems, and the chapter on the use of porous media for gas separation, including an account of gas chromatography.

Finally, the book includes an extensive and up-to-date bibliography which even the specialist reader will find most helpful. The overall result is a well-produced and welcome addition to the literature on the subject.

L. R. B.
F. A. I.

ADDITIONS TO THE LIBRARY

The Halogenated Aliphatic, Olefinic, Cyclic, Aromatic, and Aliphatic–Aromatic Hydrocarbons including the Halogenated Insecticides, their Toxicity and Potential Dangers. W. F. von Oettingen. Washington: U.S. Dept. of Health, Education, and Welfare. Public Health Service Publication No. 414. 1955. Pp. ix + 430. $2.50.

The compounds included in this comprehensive review are discussed in detail from the pharmacological and toxicological aspects, together with, in most cases, notes on their chemistry, physical constants, uses, and detection. A full bibliography is also given in respect of each substance. The space devoted to each compound naturally varies, depending on the information available, which in turn reflects to a large extent the practical importance of the material; the longest sections are those devoted to DDT (45 pp) and carbon tetrachloride (37 pp). One of the useful functions performed by a publication such as this is to direct attention to gaps in available knowledge, thereby, it is hoped, stimulating additional research.

The field covered by this publication is of somewhat limited application in as far as the petroleum industry is concerned (except perhaps for those relatively few refineries using dewaxing processes involving chlorinated solvents); the information given on the behaviour of many of the halogenated fire-extinguishing agents in contact with various types of fire is, however, of interest. The inclusion, in the text and index, of numerous trade and trivial names for the various compounds considered is a helpful feature.

International Petroleum Register. 33rd Edition 1956. New York: Mona Palmer, 1956. Pp. 664. £5 7*s*. 6*d*. (from Palmer Publications, St Paul's Corner, London, E.C. 4.)

This new edition of the International Petroleum Register follows the lines of its predecessor and lists over 35,000 firms, etc., engaged in the world petroleum industry. Of these, over 14,000 are operating firms and drilling contractors and some 21,000 are wholesale distributors, associations, and Government agencies. Companies and individuals are listed world-wide in alphabetical order, and in each case information is given regarding personnel, offices, properties, and other data likely to be of interest. This general index is supplemented by a similar index for wholesale distributors of the U.S.A. In addition there are classified sections relating to carbon black companies, grease manufacturers, petro-chemical companies, pipeline companies, refining companies, and trade associations in Government bureaux. There is also a buyers guide dealing with drilling contractors, geophysical contractors, and engineering companies.

Tests on the Efficiency of a Twin-shaft Paddle Mixer with Various Settings of the Paddle Tips. Road Research Laboratory, Road Note No. 21. London: HMSO, 1956. Pp. 12. 1*s.* 6*d.* net.

Comparatively large differences were found in composition between samples taken from various parts of a single batch from a commercial asphalt or tarmacadam mixer. This phenomenon was investigated, using a twin-shaft paddle mixer, and the effect on the mixer's efficiency caused by various settings of the paddle tips was examined. The most satisfactory type of mixer was one in which the mix was rotated in a horizontal plane by suitable setting of the paddle tips.

Evaluation of Insulating Oils—European Developments. ASTM Special Technical Publication No. 172. Philadelphia: ASTM, 1956. Pp. 76. $1.75.

European developments in the testing of transformer oils are discussed in three papers and discussion reporting research on the subject in France, Sweden, and England. Sponsored by Subcommittee IV on Liquid Insulation of ASTM Committee D-9 on Electrical Insulating Materials, this symposium is the sixth in a series on insulating oils, and was presented in the autumn of 1954. Papers included are:

Catalysts for Accelerated Ageing Testing of Transformer Oil. Halvard Liander and Gosta Ericson (*ASEA, Västerås, Sweden*).

The Performance Characteristics of Used Insulating Oil. T. Salomon (*Institut Français du Pétrole, Paris*).

The Evaluation of Inhibited Transformer Oils. R. Irving and D. W. Bravey (*The Shell Petroleum Co. Ltd., London*).

General Discussion.

ASTM Standards on Electrical Insulating Materials (with related information). Philadelphia: ASTM, 1956. Pp. 656. $6.00.

This latest edition of the compilation of standards on electrical insulating materials, sponsored by Committee D-9 on Electrical Insulating Materials, includes specifications and test methods covering various types of materials in this field. The compilation includes 83 methods of test and specifications, and two appendixes give proposed recommendations for writing statements on the usefulness of tests of electrical insulating materials, and proposed methods of test for dielectric constant and dissipation factor of aviation fuels.

The test methods include those for mineral oils for electrical insulation, and for waxes and other filling compounds.

1956 SAE Handbook. New York: Society of Automotive Engineers, 1956. Pp. 1172.

Details are included of SAE classifications of crankcase oils, transmission and axle lubricants, and automotive greases. Standards for fuel and oil hoses (SAE 30R), hydraulic brake fluids (SAE 70R), etc., are also included, and considerable data regarding automotive materials are given.

Summary of Water Flood Operations in Illinois Oil Pools during 1954. Paul A. Witherspoon, Edwin C. Jackson, and Members of the Illinois Secondary Recovery and Pressure Maintenance Study Committee. Urbana, Illinois: State Geological Survey, 1955. Pp. 63.

Proceedings of the Fourth World Petroleum Congress. Rome: Carlo Colombo, 1956. 65,000 lire.

General Volume. Pp. 365, 4500 lire.

Section I. Geology, Geophysics. Pp. xxii + 774. 12,000 lire.

Section II. Drilling, Production. Pp. xviii + 622. 10,000 lire.

Section III. Oil Processing. Pp. xxii + 560. 12,000 lire.

Section IV. Petrochemicals Products. Pp. xv + 360. 7000 lire.

Section V. Composition of Petroleum. Pp. xviii + 475. 7000 lire.

Section VI. Utilization of Petroleum Products. Pp. xix + 593. 10,000 lire.

Section VII. Construction of Equipment. Pp. xii + 278. 4500 lire.

Section VIII. Transport, Storage, Distribution. Pp. xi + 159. 4500 lire.

Section IX. Economics, Statistics, Education. Pp. xii + 152. 4500 lire.

British Standards.

B.S. 2713: 1956. 2-Ethoxyethanol (Ethylene Glycol Monoethyl Ether). Pp. 11. 3*s.* net, post free.

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OILFIELD EXPLORATION AND EXPLOITATION

GEOLOGY

1449. Recent trends in oil geology. Pt 4. J. C. M. Taylor. *Petroleum, Lond.*, 1956, **19** (8), 277.—The roles of submarine geology and geophysics in oilfield exploration are discussed. The study of submarine geology is important in providing knowledge about the ways in which past sediments were formed, and the mapping of the sea floor can provide data of immediate use for oilfield location. Geophysical measurements can now be taken on the sea floor, and various devices for collecting samples from the sea floor are available. Electronic aids can provide accurate control of position independent of weather conditions.

Drilling and production offshore are limited by depth of

water, which is related to the cost of providing drilling platforms which are strong enough to bear wave action in open waters. 2 refs. C. A. F.

1450. Geological students go underwater. W. F. Tanner. *World Oil*, 1956, **142** (7), 126.—Training in underwater geology at Florida State University is briefly described. Students are trained in skin diving and in search techniques. C. A. F.

1451. Gulf Coast tectonics. M. Bornhauser. *World Oil*, 1956, **142** (7), 113.—The history of oil and gas accumulation in the Gulf Coast is linked with the structural history of the area, which, except for the salt domes, has not been studied adequately. Several main structural types or units can be recognized, and these are tabulated in order to show their genetic relationship. The largest type is the Gulf Coast geosyncline, and within this there are subsidiary structures due to: (1) igneous activity, the best local example of which is the Jackson dome in Mississippi, and (2) subsidence. Structures due to subsidence (or gravitational activity) can be divided into regional structures such as embayments, arches, regional dips, flexures, and basement faults; and local structures such as anticlines, piercement folds, and faults. Piercement folds seem to be formed only by salt "intrusion." 9 refs. C. A. F.

1452. That Crane trend. R. L. Breedlove. *Oil Gas J.*, 25.6.56, **54** (60), 103.—The geology and development of the Crane trend in Texas and Louisiana are described. 155 wells are producing from the trend, which is a continuous narrow band of Cretaceous Pettet limestone extending E.–W. across the Sabine uplift. It divides into 3 tongues in its W. part and it has been found gas productive for 45 miles. Gas accumulation is stratigraphic and dependent on porosity development in the limestone, which may be at the top or base of the Crane section or in streaks within it. The thickest porous section is 20 ft in 2 Wurtsbourgh in the E. part of the trend. C. A. F.

1453. North Louisiana Smackover deep tests pay off. R. L. Rogers. *Oil Gas J.*, 2.7.56, **54** (61), 150.—Development of production from the Jurassic Smackover in N. Louisiana is described. The fields are associated usually with graben-faulted anticlines, but faulting does not extend into overlying beds. Seismic reflections from the formation are very poor; it is a reef limestone overlain by oolitic beds. The main field is Colquitt, discovered in 1953, where 14 producers have been drilled. This has encouraged further Smackover exploration, and 7 new fields have recently been found.

A structure map of Colquitt shows that the field lies on the W. side of a graben with production at 10,000–10,500 ft from a pay ranging from 10 to *ca* 95 ft. C. A. F.

1454. Geologically speaking . . . here's the picture in South Louisiana. J. A. Seglund. *Oil Gas J.*, 18.6.56, **54** (59), 217.—The regional geology and nature of the oil accumulations in S. Louisiana are described. The Louisiana Gulf Coast is part of an E.–W.-trending trough extending into S. Texas. The sediments of interest are Tertiary, consisting of soft sands and shales with calcareous beds in local parts of the section. Salt domes are the best known structures, and these vary in times of max growth, speed of growth, forms, and other features. Most of the production is associated with the domes, but some is related to structures along regional faults. In the upper Gulf Coast exploration follows an E.–W. trend along the lines of the faults and geophysics, and subsurface studies are used to locate related closures. The various types of salt-dome accumulations are outlined. C. A. F.

1455. Geological summary of the late Palaeozoic Horseshoe atoll in West Texas. D. A. Myers *et al.* *Oil Gas J.*, 18.6.56, **54** (59), 248.—The regional geology of the Horseshoe atoll in the Midland basin of W. Texas is described. It has been producing since 1938, but the main fields were not found until 1948, when the Scurry County reefs were discovered. The atoll supports a number of fields which produce from Pennsylvanian and Permian reefs in the Strawn, Canyon, Cisco, and Wolfcamp. It is horseshoe in form, *ca* 90 miles from E. to W., and *ca* 70 miles N.–S. The crest of the atoll is irregular, and the main fields are in the E. and S. parts. The limestone is non-bedded, composed of cemented organic clastic calcite, and porosity is almost entirely secondary, ranging up to 30% effective. C. A. F.

1456. New study of Texas basement rocks. P. T. Flawn. *Oil Gas J.*, 18.6.56, **54** (59), 260.—7 major lithological and structural groups can be recognized in the pre-Cambrian of the Texas–SE. New Mexico area. These are the Texas craton, partly exposed in the Llano uplift, the Van Horn mobile belt, the Red River mobile belt, the Fisher metasedimentary terrane, the Panhandle Volcanic terrane, the Swisher gabbroic terrane, and the Wichita igneous province. The oldest is the Texas craton, flanked by the Van Horn and Red River belts, which are probably late pre-Cambrian. The other groups, excepting the Fisher, are the youngest and may be part of the same igneous cycle. The Fisher terrane is of uncertain age. The lithology and structural features of each group are outlined. C. A. F.

1457. North Dakota's Nesson anticline. Pt 2. Madison problems are unusual. W. M. Laird and C. B. Folsom. *World Oil*, 1956, **142** (7), 136.—Reservoir characteristics of the Madison limestone in the Beaver Lodge and Tioga–Madison fields are described, and performance curves are given for 5 fields: Beaver Lodge–Madison, Tioga–Madison, Capa–Madison, Charlson–Madison, and Hofflund–Madison. Behaviour of these fields is described. C. A. F.

1458. Arizona's strip country may tell a story. F. J. Gardner. *Oil Gas J.*, 23.7.56, **54** (64), 137.—A wildcat is being drilled on the Antelope Springs anticline in the Kanab–Fredonia basin in N. Arizona, one of the few virgin basins in the U.S.A. There is a thick section of marine Palæozoic rocks which are strongly faulted. There are many potential traps, and shows have been found. Since 1950 the area has been surveyed by surface methods and airborne magnetometer. C. A. F.

1459. Citronelle leads Alabama to front ranks. F. J. Gardner. *Oil Gas J.*, 25.6.56, **54** (60), 153.—The recently discovered Citronelle field in Mobile County, Alabama, has an estimated reserve of 100,000,000 brl in the Rodessa pay sands. Production is *ca* 81,000 brl/month, and 19 producers have been completed. The structure appears to be a broad anticline with 1000 ft relief, with lenticular development of pay sands which are below 10,000 ft. C. A. F.

1460. Gas reserves increase in New Harper County field. N. S. Morrisey. *Oil Gas J.*, 2.7.56, **54** (61), 166.—A gas-producing area in Laverne, Harper County, Oklahoma, has been discovered. There are 4 pays above 7500 ft with production from Hoover, Tonkawa, Morrow, and Chester sands. Several wells are dual producers, and initial potentials of 100 million cu. ft. gas/day are not uncommon. C. A. F.

1461. Muskeg access, with special reference to problems of the petroleum industry. N. W. Radforth. *Canad. Min. metall. Bull.*, 1956, **49** (531), 473–9.—In Canada the significance of muskeg, which may be very briefly defined as "organic terrain," lies in the fact that it is found in vast areas of the country awaiting exploitation. A system of classifying muskeg for engineering needs has been proposed, and the accumulation of the underlying peat is discussed.

Air surveys and air-form patterns are also discussed and, for petroleum surveys, primary steps leading finally to exploitation are suggested. 8 figs, 5 tables. M. P. T.

1462. In SW. Ontario gravity survey pays its way. W. B. Dyer. *Oil Gas J.*, 9.7.56, **54** (62), 86.—Gravity surveys in SW. Ontario have proved economically successful in reef exploration. During 5 years work on gravity anomalies 24 reefs have been found, of which 2 are potential oil producers. Limitations of the gravity method are stressed, and the

importance of a combination of geological and geophysical methods in the area is emphasized. C. A. F.

1463. Cuban strike promising. Anon. *Oil Gas J.*, 9.7.56, **54** (62), 72.—A well drilled 4¼ miles SW. of Jatibonico field in Cuba (1 Catalina) on test produced an estimated 25 brl/hr of 35° oil from limestone at 7107–7137 ft. The well is in the central basin, and was drilled on a large anticlinal feature outlined by seismic work.

Cuba is currently producing *ca* 1600 b.d., mostly from Jatibonico. C. A. F.

1464. New wildcat spudded in Iran. Anon. *Oil Gas J.*, 2.7.56, **54** (61), 79.—A new wildcat is being drilled in Persia, nr Ahwaz, on a site abandoned in 1951 when the fields were nationalized. *Ca* 75% of Persia's production now comes from Agha Jari, discovered in 1937, where the field limits are undefined. Development wells are being drilled in this field, and there is workover at Haft Kel. Future development and drilling at Naft Safid are also planned.

Geological work is being carried out in the coastal areas of Laristan and Kerman. C. A. F.

1465. Saudi Arabia wildcat hits. Anon. *Oil Gas J.*, 25.6.56, **54** (60), 83.—1 Kharsaniya, 19 miles N. of Fadhili and 18 miles ESE. of Abu Hadriya on the Persian Gulf coast, on test flowed 2200 b.d. from the top 22 ft of the Arab zone at *ca* 6000 ft. G.O.R. was 340 : 1 and gravity 32°–33°.

C. A. F.

1466. Aramco trying for deeper pay zones. Anon. *Oil Gas J.*, 2.7.56, **54** (61), 79.—1 Kharsaniya, 18 miles ESE. of the Abu Hadriya field, Persian Gulf, is reported as a major discovery, testing 2200 b.d. from the Arab zone. The Cretaceous, which is productive at Safaniya, was dry. Further testing of the well is being carried out. C. A. F.

1467. Note on the massive limestones of the Garzan structure. M. Tasdemiroglu. *Rev. Inst. franç. Pétrole*, 1956, **11** (4), 452–5.—The Garzan structure of SE. Turkey runs NW.–SE., and has dips of 8°–12° on the N. flank and over 45° on the S. In this region Devonian to Cretaceous beds occur, and the petroliferous horizon is in the Turonian, consisting of massive limestone. Marly and pyritic limestones with an abundance of large foraminifera rest on the reservoir with slight discordance; marls, sandstones and conglomerates, and then more limestones follow.

The massive limestones lack stratification and are cavernous. They differ in various respects from the Raman reservoir rock, although belonging to the same series. They have a micro-breccia texture showing rounded or angular Hippurites debris, and there is also a compact texture, more homogeneous and with smaller fragments. These characteristics suggest a reef facies. Transitions between the 2 types give the best oil production because of superior porosity and permeability, while the micro-breccias are second in importance.

Minerals derived from granites, schists, gneisses, and pegmatites have been found in the massive limestones. Authigenic quartz crystals as well as detrital grains are found.

G. D. H.

1468. Second Sahara strike. Anon. *Oil Gas J.*, 25.6.56, **54** (60), 81.—A well at Tig Uentourine in Algeria, nr the Libyan border, has found oil. It is *ca* 40 miles W. of Edjele 101, which tested 19 brl/hr of light oil from Carboniferous sandstone at *ca* 1475 ft. The new well may be testing the same structure, and the area may prove to be of considerable importance. C. A. F.

1469. New wildcat spudded as drills busy in Africa. Anon. *Oil Gas J.*, 2.7.56, **54** (31), 78.—A wildcat is being drilled in Somalia *ca* 27 miles from the coastal town of Obbia. The well was sited following over 3 years of geological and geophysical work. 350 miles NE. another wildcat is being drilled 12 miles W. of Bender Beila, and in British Somaliland geophysical and geological work is being carried out. 2 wells have been drilled and suspended in Ethiopia. C. A. F.

1470. Correlation in the marly Lias of the Causses Majeurs. Dept of Sedimentary Geology of the Institut Français du Pétrole. *Rev. Inst. franç. Pétrole*, 1956, **11** (4), 439–51.—Samples from the Lias of the Causses Majeurs, in Lozère, S. France, have been examined mineralogically and palæontologically. The stratigraphy is well known because of the ammonite zones. The 5 main sections were spread over some 40 km. The fraction finer than 40 μ was examined by X-ray spectrometry, using a Norelco instrument. Quartz, kaolinite, micas and illites, chlorites, pyrites, and felspars were determined. The Infra-Lias is arkosic, with variegated clays which are illitic. The marls of the Lower Lias are mainly illitic, kaolinite being absent or present in minor amounts. In the Middle and Upper Lias kaolinite, which does not exceed 25% in the Domerian, increases throughout the Toarcian to a max of 40% at the Toarcian–Aalenian junction; it then diminishes. However, in the Frayssinet de Fourques section the Middle and Upper Lias do not show the mineralogical zones defined in the other sections; indeed, the characteristics are such as would be expected if only the upper Toarcian and Aalenian were present. The results in general suggest the feasibility of mineralogical correlation.

The ostracods and foraminifera were also examined. Tables show the distribution of the various forms, while diagrams summarize the mineralogical data. Links between the 2 sets of data were evident. G. D. H.

GEOPHYSICS AND GEOCHEMICAL PROSPECTING

1471. Scintillation—practical approach to oil and gas exploration. G. A. Haddad, Jr. *Oil Forum*, 1956, **10**, 92–3.—Use of γ-ray radiation intensity as a geophysical method for determining oil and gas production is described. Technique for radiation interpretation, misinterpretations, and practical applications are discussed. R. T.

1472. Seismic prospecting in Middle East. T. F. Gaskell. *Oil Forum*, 1956, **10**, 242–3.—Drilling of deep shot holes slows up seismic operation. Good results are obtained by firing a pattern of 5 small shots at 50 ft depth simultaneously. Operations of M.V. *Sonic* off Trucial coast in water 10–100 ft deep—making seismic reflection measurements at rate of 100 km prospected line/day—are described. R. T.

1473. Results of recent exploration activity in Rehden–Aldorf region. E. Brand. *Erdöl. u. Kohle*, 1956, **9**, 2–9.—In the Portland period a very flat dipping S. flank of the Bockstedt–Drentweder uplift is crossed in the oldest Portland by a Rhenish-running axis. A basin axis exists in the S. From the Wealden to the Santon a stepwise N. displacement of this basin axis close to the uplift axis Bockstedt–Drentweder axis (*ca* 19 km), also a temporary general sinking during the Alb-Senoman, cannot disturb this displacement. Along therewith a displacement of the uplift axis of Dornstorf, which announces itself from the Barrême in region Düste, and finally, during the Subhercyne phase, leads to an orogenic curving. From the same orogenic phase also the region of the effective uplift axis Bockstedt–Drentweder from Portland to Santon is arched, and in part overthrust to the N. region. During the laramic movements, however, the structure Düste is strongly curved, whilst the structures Bockstedt and Ridderade undergo no noteworthy distortion. R. T.

DRILLING

1474. What factors are contributing to increased drilling rates. W. R. Wardroup and G. E. Cannon. *World Oil*, 1956, **142** (6), 117.—Drilling rates have steadily increased in the U.S.A. in recent years, but this has not reduced well or footage costs, which have increased. The rise in well costs could be stopped or reversed if more care was given to basic factors which effect drilling rates and the use of specialized equipment and new techniques. The effects of some of these, such as improved bits and drill collars, are described. C. A. F.

1475. After the turbo-drill. W. Tiraspolsky. *Bull. Ass. franç. Tech. Pétrole*, July 1956, 291–310.—A study of the specific power transmitted to the bit as a function of the total power applied shows that for cable tool it is *ca* 20 watts/cm² for 17½-inch bits and 60–70 watts/cm² for 4½-inch bits; for the classic rotary the max is *ca* 80–100 watts/cm².

Kapeliushnikov patented the turbo-drill in 1922, and after much experiment drilling by turbo-drill was 6·9% of the total Russian footage in 1945, and increased to 85% in 1955. Experience shows that the turbo-drill only comes into its own on a large scale when formations are hard, adequate pump power is available, and the rotary has reached the limits of its possibilities for the present.

Consideration of the principles involved in applying the turbo-drill indicates that the axial thrust is most important. All the earlier turbines functioned more or less well, but the abrasive effects of the drilling mud limited the life of the blades and reducers to a few hr. The aim became to have a turbine with a life as long as that of the bits. Before the war multiple-stage turbines became of interest, and in the U.S.A. these were used without reducers. One of the obstacles to success was insufficient power. Nevertheless, the Edco-drill succeeded in drilling 600 m consecutively at 40 m/hr, which rate was considerably better than the rotary in the same formations. Some work was carried out in Yugoslavia and Germany. French activity was restricted to the period 1924–28, and from 1954 onwards, when the Neyrfor turbine was used. Recent French turbo-drills have had an operating life of over 50 hr, which compares with *ca* 70 hr for Russian equipment in Austria. Success has resulted from careful consideration of the 3 elements involved, turbine, bit, and rock. At Saint-Bauzille-de-Montmel a turbo-drill penetrated 485 m in 55 hr, the rates being 3·1–36·3 times those for rotary under corresponding conditions. Good results were obtained at Lacq 113 and Mothes 3. 40 similar turbo-drills are planned for use in the second half of 1956. These have 80 stages, are of 220–320 h.p. and have axial thrusts of 15–20 tonnes, and are intended for areas where rotary advance is under 2 m/hr, and possibly 1 m/hr. 100-stage turbines are under consideration. G. D. H.

1476. Economics of the conversion of rotary to turbo-drill in the light of the first results from Saint-Bauzille-de-Montmel. W. Tiraspolsky, R. Rouvière, and J. Charé. *Rev. Inst. franç. Pétrole*, 1956, **11** (2), 190–6.—Early in Jan 1956 the first turbo-drill was put into field operation at Saint-Bauzille-de-Montmel. It used Neyrfor turbines, and various bits: OWS and W7R Hughes, special SMF and TD Granges. The formations were mainly compact marls, marly limestones, and more or less siliceous limestones. In some zones, especially the harder ones, the rate of advance was *ca* 30 times greater than for conventional rotary, but it must be recognized that strong dips limited the weight which could be put on the rotary bit because of the risk of deviation.

The various factors involved in a quantitative and cost comparison of the rotary and turbo-drill are discussed. It is concluded that for many of the French wells turbo-drills will pay, and this applies not only to the 10-inch turbine, but probably even more to the 7½-inch turbine being developed, and probably also to the 10-inch turbo-corer.

The turbine had 80 stages, was *ca* 8·35 m long, and for a mud of density 1·1 flowing at 43 l/sec, and a pressure drop of 55 kg/cm², the theoretical h.p. was 210 and speed 700 rev/min. G. D. H.

1477. Parentis oilfield in Aquitaine basin (South-West France). H. Hlauschek. *Erdöl u. Kohle*, 1956, **9**, 65–72.—Geology and stratigraphy of the Aquitaine basin are described with maps. First drilling in Ostend seismic anticline N. of the line Mimizan–Agen began in 1953, stopped at 2057 m, was renewed in 1954, and showed fluorescence in drilling fines at 2223 m. During core drawing circulation loss occurred; the core consisting of oil-impregnated dolomite. The first test of the interval 2254–2264 m (1954) yielded 2800 l oil in 20 minutes. Final investigation gave 550 m³/day through a 12·8-mm nozzle —gas–oil ratio 6 : 1—bottom pressure referred to 2200 m = 225·7 kg/cm². Final well depth = 2398 m cased to 2239 m. Tectonic of the Parentis anticline is not fully known, cross-disturbances exist, generally western blocks are displaced northwards. Age of fracture formation shows that Jurassic and Neocomian are more fractured than Upper Cretaceous, and this more than Eocene. Small fractures may occur in more recent Tertiary. The main part of the Parentis Anticline lies under the sea; drilling is described. Water–oil contact lies at *ca* 2407 m drilling depth. Total production from May 1954 to end of Dec 1955 = 707,000 tons. 10 refs. R. T.

1478. The Parentis field; development of under-water drilling. P. Ducrest. *Bull. Ass. franç. Tech. Pétrole*, July 1956, 333–51.—In April 1954 Parentis 1 reached a depth of 2398 m, and production of 175 m³/day on a ¼-inch choke was obtained at 2255–2265 m. 17 wells have now been drilled, 3 in the middle of the lake, and one now drilling is in 16 m of water. The lake is *ca* 8 km wide at its max, and is separated from the sea by dunes. The E.–W. axis of the anticline is roughly the median line of the lake. The reservoir is fractured, irregularly dolomitized limestone.

Plans had to be made for drilling an unknown number of wells in water 1·5–20 m deep, at sites which would not be known long in advance of drilling. A base was built at Biscarosse-Hourtiquets, and in May 1955 the first off-shore site was ready. It had a reinforced concrete platform 16·77 × 9·9 m, supported on 36 reinforced concrete piles; a wooden platform 22 × 23 m on 108 piles served as a pipe rack, and another on 290 piles and 20 × 30 m in dimensions supported aux equipment. Suitable construction prevented pollution of the lake. The first offshore well was drilled to 2454 m in 2 months, being completed at the end of Sept. Later platforms had fewer piles and prefabricated beams. For transport 5 pontoons suitable for loads of 60–100 tonnes, 3 mud barges, one gas oil barge, and a pontoon for aux operations were provided. Some constructional details of the platforms and transport equipment are given.

The Parentis gathering and shipping arrangements are described.

The millionth tonne of crude was produced at the end of April 1956, and the daily production attained 3100 m³. G. D. H.

1479. Mud filtration at the bottom of the borehole. I. Havenaar. *J. Petrol. Tech.*, 1956, **8** (5), 63.—It has previously been assumed that filtrate does not flow freely into the bottom of the hole, the pores being plugged by mud. However, if the bit blades remove the cake, which is reformed after the blade passes, then: $Q_f = \pi r^2 \sqrt{\frac{2nm}{C}}$, where r is the radius of the hole, n the number of blades or cones on the bit, m the bit rev/sec, C a constant, and Q_f the vol of filtrate passing/sec. C is obtained from API filter losses. The values calculated by this formula are of the right order of magnitude, but usually less than the experimental values. The errors may be due to some erosion by the mud stream and to C being too large because the API test used a lower pressure differential. G. D. H.

1480. When lost-circulation besets you. C. C. Liedholm. *Oil Gas J.*, 2.7.56, **54** (61), 88.—There are 3 ways of combating lost circulation: drilling without returns, using preventive methods, and attempting to repair circulation after its loss. Advantages and disadvantages of each of these are briefly described, but the selection of a method is primarily dependent on costs. C. A. F.

1481. It's easier to regain circulation if you know where you lost it. C. F. Gallagher. *Oil Gas J.*, 2.7.56, **54** (61), 85.—Methods of locating zones of lost circulation are described; these are spinner surveys, radioactive tracer methods, temp surveys, and lost circulation and fluid velocity indicators. Spinner surveys are useful but liable to jam. Temp surveys have been used for many years, and are most successful when there is a good temp gradient and a large rate of loss. The

lost-circulation detector designed for this purpose involves ejecting into the mud column a fluid of low resistivity and then detecting the flow of the fluid past electrodes; no movement will be indicated below the zones of loss. Another instrument, the fluid velocity indicator, uses a short tube and swage to restrict part of the flow of mud in the hole. The resulting pressure differential operates a system of electrodes, and mud flow is indicated by displacement of electrodes causing a signal to be recorded at the surface. 2 refs.
C. A. F.

1482. You can reduce lost-circulation problems. Pt 1. E. H. Clark. *Oil Gas J.*, 2.7.56, **54** (61), 80.—Ways of minimizing circulation loss during drilling are described. Lost circulation may be due to excessive mud weight build-up, poor mud conditioning, fast pipe handling, or mud-pump shock pressures. A high proportion of cases is due to pressure surges from pumping or pipe handling, and pressure reducing practices are therefore of great importance. 8 procedures are recommended as standard practice: (1) increase running or pulling times to keep pressures above hydrostatic but below formation strength; (2) control acceleration rate by smoother brake handling; (3) use bottom fill devices to relieve annulus pressures; (4) increase clearances wherever possible; (5) use care in choosing projections above pipe size; (6) use care in spudding back through previously drilled beds with high rates of pumping; (7) break circulation slowly; and (8) maintain adequate control over mud properties. A series of charts show instantaneous variations in BHP while running or pulling a stand, BHP variations during a normal drilling cycle, during lost circulation caused by build-up of mud weight, and for lost circulation due to balled-bit.
C. A. F.

1483. Drag forces on an accelerated cylinder. A. D. K. Laird and C. A. Johnson. *J. Petrol. Tech.*, 1956, **8** (5), 65–7.—In the design of offshore structures wave forces acting on immersed cyl are of importance. Various experimental and theoretical investigations have been made, and the work now described was concerned with measuring drag forces on a circular cyl subjected to linear accelerations over the range of Reynolds No. between 10^4 and 10^5, where the drag coeff was a constant for constant velocities. The drag coeff were measured at constant velocity and at constant linear acceleration. Those for the first condition showed reasonable agreement with previous results, and corrections gave values of 1·12–1·18 for the equivalent infinite cyl. The drag coeff for accelerated motion tended to be ca 5% lower than for uniform motion, but there was no well-defined trend with acceleration. Plots of resistance coeff as a function of modulus (AD/V^2) show scatter at low values of the modulus, as found by others (D is dia, A is acceleration, and V is velocity).
G. D. H.

1484. Slim holes. P. L. McLauchlin. *Oil Forum*, 1956, **10**, 23–7.—Slim hole drilling—most suitable for exploration and wildcat wells—reduces daily rig and overall drilling costs. The net result of the grouped problems is greater risk and reduced drilling costs.
R. T.

1485. Slim hole drilling helps some contractors improve profit position. P. H. McLaughlin. *Oil Forum*, 1956, **10**, 127–31.—Slim hole contractors underbid big hole rivals 10–20% profitably. Economies include reduced tonnage of iron removed and No. of loads per rig. Further reductions are drill string costs (¼ anticipated), bits (20–30% less), labour costs (20%), repairs (⅓), fuel, trip time (up to 20% on medium depth holes), drilling time.
R. T.

1486. New down-hole tool for oil-well milling. J. Chadderdon and C. O. van Note. *Oil Gas J.*, 9.7.56, **54** (62), 80.—A new method of suspending particles of tungsten carbide in a tough and elastic matrix for use in milling wells is described. Conventional methods used for fixing the carbide to tool holders were not successful in down-hole conditions, as it is inherently sensitive to shock. In the new method the particles are suspended in a resilient matrix which acts as a shock absorber. The use of the material in drilling operations, particularly in whip stocking, is also described.
C. A. F.

1487. Hydraulic system of modern deep well installations. B. Petuch and E. Williams. *Erdöl u. Kohle*, 1956, **9**, 103–7, 178–80.—Pt I. Provisions and equipment of modern mud pump installations—discussed and illustrated—provide a new field of vision for the drilling engineer.

Pt II. Improved flushing and drilling methods, new pump types in oilfield and offshore drilling are important for all specialists. Illustrations and descriptions appear.
R. T.

1488. Contemporary methods of cementing oil and gas wells. V. Peros. *Nafta* (*Yugoslavia*), 1956, **7** (6), 161–71.—The cementing of protecting pipe columns and lines, cementing under pressure, construction of cement bridges, cementing plants, various sorts of cement and their admixtures, functions of EK-diagrams, "Kaliper" diagrams, and temp diagrams are discussed. The importance of the choice of cement and admixtures is stressed and the qualities of Yugoslav and American cements compared. (Author's abstract.)

1489. Lightweight, low water-loss, oil emulsion cement for use in oil wells. G. K. Dumbauld, F. A. Brooks, B. E. Morgan, and G. W. Binkley. *J. Petrol. Tech.*, 1956, **8** (5), AIMME Tech. Paper No. 4240, 99–104.—Oil well cements have been developed with low densities, controlled set strengths, and satisfactory thickening times. With the development of permanent-type well completion techniques water loss has become of importance, and based on experience with oil-emulsion drilling fluids oil-emulsion cements have been prepared. Lab studies have shown cement slurries of oil, water, bentonite, cement, and calcium lignosulphate to have satisfactory properties for primary cementing and squeeze cementing in permanent-type well completions. The cements ranged 60 cc water and 20 cc oil/100 g cement to 90 cc water and 45 cc oil/100 g cement, while calcium lignosulphate was 0·4–5% of dry cement wt and 2% of bentonite was found suitable. The slurries weighed 11·4–13·1 lb/gal, had filtration rates of 10–100 cc in 30-min API tests at room temp, and gave 60–220 p.s.i. tensile strengths after one day. The filtered mass had tensile strengths of 60–150 p.s.i. in 12 hr, and 320–515 p.s.i. when cured at 125° F for 7 days.

11 out of 13 field tests were satisfactory. It was found most convenient to emulsify the oil, water, bentonite, and lignosulphate before adding dry cement in the field.
G. D. H.

PRODUCTION

1490. Oil recovery increased 25 per cent. E. McGhee. *Oil Gas J.*, 18.6.56, **54** (59), 233.—The use of low pressure gas injection and hydraulic fracturing in the Boyle field, Texas, are described. The field is a stratigraphic trap with a net oil sand thickness of 12 ft and indicated primary production was only 13·8% of oil in place. Gas injection commenced in 1951 after the field had been producing for 6 years and with a prospective life of only 2 more years. Since 1951 production has been maintained, aided by fracturing. Cumulative production has given a recovery of 17·2% of original oil in place, and much more oil can be produced before depletion. Charts show production and injection history, and a contour map of the field is included.
C. A. F.

1491. World's deepest hole now producer. Anon. *Oil Forum*, 1956, **10**, 214–15.—World's deepest well—Humble-L1&E No. 1-L—is now completed. Potential flow from 2 closely spaced sections of the Miocene 21,419 and 21,465 ft = 207 b.d. of 42·9° API crude through a $\frac{14}{64}$-inch choke; for gas : oil ratio 1·179 : 1, less than 1% BS&W; gas vol = 244,000 cu. ft/day.
R. T.

1492. 80% oilfield recovery now proven an economic feasibility. R. Garbus. *Oil Forum*, 1956, **10**, 210–12.—Unrecoverable crudes in the U.S.A. amounted to 12% of total domestic reserves in 1953. Of processes tested and discussed here, thermal recovery technique is the most promising. A fraction

of the crude is consumed at <400° F in presence of O_2 in injected gas mixture. Visc of the remaining crude is lowered. Recovery of injected dry gas = 50%, total production rate = 19,000 brl/acre. R. T.

1493. Planning a fracture in a new area? G. L. Gore. *World Oil*, 1956, **142** (6), 174.—Factors to be considered in planning a fracture programme are described. A detailed preliminary study of the formation characteristics is required before specific recommendations for treatment are made. Each fracture treatment consists of breakdown, fracture, and over-flush. The fracturing fluid must open a fracture, carry sand, and return readily to the well bore, and a number of types are available. These are listed and their behaviour described. A table listing general fracturing problems, conditions of treatment, and corrective action is included. C. A. F.

1494. What size fractures? R. C. Clark. *World Oil*, 1956, **142** (6), 159.—The effect of size of fractures, as defined as the radius or depth of penetration into the formation, on well production is discussed. Fracture size depends on matrix permeability, characteristics and vol of the fracturing fluid, fluid loss, and injection rate. Productivity is increased as a result of increasing flow by changing the flow pattern around the well bore. It is concluded that productivity should increase in proportion to the size of the fractures up to a fracture depth equal to ½ the distance to offset wells and that one long fracture generally gives better results than several short ones. Extended fractures need fracturing fluids with low fluid loss. C. A. F.

1495. What fracturing has done for the San Juan basin. B. G. Taylor. *World Oil*, 1956, **142** (6), 164.—The use of fracturing techniques in the San Juan basin, New Mexico, is outlined. Much of the development of the gas fields in the basin has been due to their application. There are 2 main gas producing formations, the Pictured Cliffs and the Mesa Verde, and prior to the introduction of fracturing, most wells were completed in open hole after nitroglycerine shooting. Recently water has been used successfully as a carrying medium for sand in the fracturing techniques. C. A. F.

1496. Bled Eddoum field (Morocco); hydraulic fracturing raises potential of well from 1·5 to 150 m³/day. R. Sorel and F. Vermersch. *Bull. Ass. franç. Tech. Pétrole*, July 1956, 313–31.—Various means have been used for stimulating oil flow through the reservoir rock: removal of contamination or blocking matter, shooting, acidization, all of which involve a small vol of rock. In hydraulic fracturing the effects may be more widespread, and some outstanding results have been obtained. This fracturing uses a variety of suspending media and means of eliminating these as required. The visc must be high to keep the sand in suspension, and to permit appropriate pressure to be developed. The fluid must be compatible with formation fluids. The sand must be suited to the formation to be fractured, and is often 0·4–0·8 mm dia; its concn may be 120–350 g/l; 300 m³ of fluid may be used with pressures as high as 700 kg/cm².

At Bled Eddoum production is obtained from the Palæozoic and Mesozoic. DM 20 produces from the latter at 1298–1378 m, the rocks being alternating sandstones, limestones, and marls. The porosity of the impregnated sections averages 20% and permeability 200 mD. This well flowed for 2 months; a pump was installed, giving 4 m³/day, but later the output fell to 0·5 m³/day. The formation was thought to be mud-blocked, because other wells drilled with oil-base mud were much better.

The suspending medium was a fuel oil with a visc of 690 cP at 27° C; the sand was of 0·4–0·75 mm dia. Perforations at 1333–1338 m were selected for injection and were isolated by a straddle packer. The equipment employed for mixing and injecting the fluids and sand are described, together with the successive stages in the operation. 28,000 l of fuel with 2500 kg of sand were injected in 126 minutes, and this was followed by 2500 l of crude in the formation. During the first day of swabbing there was a marked rise in output, and when on the pump the output was 31 m³/day, including 8% water. After adjustments it rose to 44 m³/day with 7% water. The cost of the operation was 770,000 fr (420,000 fr for materials), and the pay-off took place in 3 days. G. D. H.

1497. Gas drive and gravity drainage analysis for pressure maintenance operations. D. R. Shreve and L. W. Welch. *J. Petrol. Tech.*, 1956, **8** (6), AIMME Tech. Paper No. 4254, 136–43.—In order to predict the behaviour of high-relief reservoirs producing under combined gas drive and gravity drainage, and with the pressure maintained by gas injection, the reservoir has been represented by a set of right prisms stacked vertically. Each zone has the same vol and vertical dimensions as the actual reservoir. A reduced permeability is used in the equations to compensate for geometrical distortion. The theory based on these and other assumptions is set out, and a function relating the volumetric velocity of the flowing phases and the oil saturation is derived and discussed. This shows several phases: both gas and oil flowing down-structure, gas flowing up-structure, saturation moving up-structure, and gas immobile. The conditions under which these exist, and the saturation distributions and movements are described, together with the effects of change in throughput rate and of down-structure injection.

The application of this method of analysis to the Six Mile pool is briefly outlined.

It is concluded that the method can be applied in the field, using desk calculators, but that card programmed calculators would save much time in some parts of the analysis. G. D. H.

1498. Effect of gas composition upon oil recovery by gas drive. H. L. Stone and J. S. Crump. *J. Petrol. Tech.*, 1956, **8** (5), AIMME Tech. Paper No. 4248, 105–10.—Lab tests have been made in a horizontal sand-packed steel tube using a light volatile crude (47·5° API) in one case and a heavy asphaltic oil (18·9° API) in the other. Separator gas, condensate gas, a propane-rich gas, and an ethane-rich gas were used as the displacing agents. The gas solubility, swelling, and the visc of the swollen oil were determined for each combination. It was found that the more soluble the gas in the oil to be displaced, the more efficient was the gas as a displacing agent. The increase in recovery was found to be a function of the amount of swelling caused when the gas dissolved in the reservoir oil. With the ethane-rich gas essentially all the charged oil (47·5° API) was recovered by injecting only 1·4 pore vol of gas at 2000 p.s.i.g. and 128° F. For the separator gas and heavy oil the effective recovery of the latter was 54% when the fluid injected was 3·3 pore vol at 5000 p.s.i.g. and 210° F.

It is concluded that the use of condensing gas drives would give increased oil recovery from many reservoirs during the primary or secondary phases of oil recovery. G. D. H.

1499. Elements of the mechanics of fluids in porous media. A. Houpeurt. *Rev. Inst. franç. Pétrole*, 1956, **11** (4), 456–87.—The discussion of transient radial flow is continued, and relationships derived for the evolution of pressure in space and time, and for the rate of flow and cumulative production. Various theorems and transformations are recalled. The idea of a point source is introduced, and also of the presence of a number of instantaneous point sources. The application of the principle of superposition is described, and interference between wells is examined. G. D. H.

1500. Control that fluid loss. J. G. Davis *et al.* *Oil Gas J.*, 2.7.56, **54** (61), 102.—The history of hydraulic fracturing and the mechanics of fracture extension are described. A practical formula is derived to determine the radius of fracture. Field results and calculations show that fluid loss is critical in fracture extension, treatments with low fluid loss fracturing liq show better results than equivalent conventional treatments, and fluid loss control has more effect on fracture extension than the injection rate and visc of fracturing fluid. 5 refs. C. A. F.

1501. Effective and relative permeability of porous oil reservoir rocks. C. Schmid. *Erdöl u. Kohle*, 1956, **9**, 73–6.—Darcy's law is applicable to relating changes in permeability to changes in rock body and flow path. Sp changes of flow path in porous stone exist if the pore space be filled with several media not mutually sol, *i.e.* oil, salt water, and gas in oil deposits. The system oil–salt water is considered. Using the D law on each of the 2 liq a permeability is obtained for oil and for salt water. These together are denoted effective permeability. From the ratio effective permeability–permeability for salt water at full core saturation with salt water, relative permeability is obtained. Effective and relative permeability depend largely on core saturation conditions. With oil saturation 0–20% no salt water flows, when >70% only oil can flow, between 20 and 70% both liq can flow through the rock together. Basically, it is possible, from changes of effective permeability of the whole entry range of a well, to decide, by means of permeability curves, on changes of the inundation degree of the entry range. Peculiarities of the effective permeability of oil reservoir rocks rest on capillary structure. Measuring arrangements and error sources are described. A suitable apparatus is developed to avoid the end effect. Transfer of lab results to reservoir conditions is discussed. 20 refs. R. T.

1502. Calculation of oil in place of reef reservoirs. R. W. Hillyer. *Oil Gas J.*, 2.7.56, **54** (61), 109.—Conventional volumetric calculation of oil in place assumes that only effective porosity and permeability are found in intergranular spaces of the rock, whereas reef limestones have porosity and permeability which are heterogeneous. A new calculation procedure is recommended for reef reservoirs in which all porosity, permeability, and connate water values are totalled, obtaining a gross average for each, instead of the usual method of selecting an arbitrary point of delineation between pay and non-pay. C. A. F.

1503. Theory of dimensionally scaled models of petroleum reservoirs. J. Geertsma, G. A. Croes, and N. Schwarz. *J. Petrol. Tech.*, 1956, **8** (6), AIMME Tech. Paper No. 4255, 118–27.—Cold-water and hot-water drives and solvent injection are the 3 oil recovery mechanisms considered, and the dimensionless groups into which the variables governing oil displacement from reservoirs can be combined are derived. The relevant basic equations are employed via inspectional analysis, and the sets of groups so obtained are then completed by dimensional analysis. The groups are presented in forms suitable for subsequent adaptation to the boundary conditions met in practice, and their physical meaning is discussed. A 2-dimensional system is considered.

It is concluded that dimensionally-scaled models can be realized only if the average pore size need not be scaled. For most practical models inertial forces are not significant in the range of interest, and so the Reynolds group can be omitted, but experiments may be needed to find the conditions under which the omission of this and possibly other groups is permissible. G. D. H.

1504. Performance calculations for combination drive reservoirs. L. D. Wooddy and R. Moscrip. *J. Petrol. Tech.*, 1956, **8** (6), AIMME Tech. Paper No. 4253, 128–35.—Simultaneous solution of the volumetric balance and unsteady state equations makes possible calculation of the volumetric changes of fluids in the gas cap, oil zone, and aquifer arising from fluid withdrawals and reservoir pressure changes. The fluid distribution changes associated with the volumetric changes are also important, for these indicate the efficiency of water or gas as the oil-displacing agent, and serve as a guide in predicting ultimate oil recovery. A procedure is presented for solving simultaneously the volumetric, unsteady state, and displacement equations in order to give this fuller knowledge. The procedure has been applied to analysing past performance and to predicting future behaviour of combination drive reservoirs under primary and pressure-maintenance control. Satisfactory matching of past behaviour has been obtained for 2 reservoirs which appear to be *ca* 50% depleted. G. D. H.

1505. Review of drill-stem testing techniques and analysis. W. M. Black. *J. Petrol. Tech.*, 1956, **8** (6), 21–30.—The components of drill-stem testing equipment and their functions are briefly described, and factors to be considered in planning a test are discussed. The various procedures are outlined.

Interpretation of drill-stem test data is most important. Sampling of recovered salt water at different depths in the pipe can be most helpful, while a study of the pressure bomb charts will show whether the test has been mechanically satisfactory. Means for estimating the open-flow potentials and productivity factors are outlined, and charts for estimating gas–oil ratios are given.

Pressure charts indicative of satisfactory tests with and without critical flow, and charts showing various types of misrun are presented and discussed, and a sample interpretation of drill-stem test data is given. G. D. H.

1506. Perforating "around the corner." R. L. Doyle. *World Oil*, 1956, **142** (6), 170.—The development of a wire line fracturing gun which turns missiles 90° into a formation is described. The tool has 3 segments; a powder chamber, acceleration chamber, and a direction channel of cast iron for directing the missile. It has been used for production and junk shooting in many areas, and has been found very useful where holes must be enlarged, and tight formations require fracturing. C. A. F.

1507. Effect of dip on five-spot sweep pattern. C. S. Matthews and M. J. Fischer. *J. Petrol. Tech.*, 1956, **8** (5), AIMME Tech. Paper No. 4250, 111–17.—A model consisting of 2 glass plates *ca* 1 mm apart, with suitable holes representing wells, has been used to study sweep patterns in a tilted reservoir. The flooding liq was slightly-diluted glycerine, and the reservoir was assumed to be depleted of primary oil and to have a gas phase. Before interference the injected fluid was almost circular about the injection well for the cases studied (injection wells on square pattern, with side or diagonal parallel to strike). The circles moved down dip at *ca* ½ the rate at which the fluid would move down dip under the action of gravity alone. The correct drilling position for the production well is that which gives equal times of oil-bank breakthrough from all wells. Plots show the correct position for the production well for different ratios of the visc and gravity forces and ratios of the square roots of the production rates.

The injectivity was found experimentally to be about the same for a dipping reservoir as for a horizontal reservoir.

In the most extreme case studied the ratio of the major and minor axes of the ellipse was 1·1, and this corresponded roughly to flooding at 12·5 b.d/ft in a 40-mD formation dipping at 40°. G. D. H.

1508. Dual-zone rod pumping with both zones vented. P. M. Bennett and R. M. Willis. *Oil Gas J.*, 23.7.56, **54** (64), 102.—Equipment for pumping both zones of a dual zone well is briefly described with diagrams. A single pumping unit and rod string are used, and it has proved satisfactory in practice. It is particularly useful for shallow to medium depth wells where there is 1¼-inch casing. C. A. F.

1509. New idea in thermal oil recovery. R. Garbus. *Petrol. Engr*, 1956, **28** (4), B83.—A field test of the thermal principle of recovery is being carried out in the Parker field, Clark County, Illinois. The formation is heated with a hot gas-steam mixture, and as the temp of the sand increases and visc of the oil decreases, driving gas introduced at injection wells moves the hot oil to output wells. Pay is a sand approx 35 ft thick at a depth of 275–310 ft, and there has been little natural production from the field. Water drive tests have not been successful. Thermal tests were started in 1953, and very high recovery rates have been obtained. C. A. F.

1510. Use of lightweight mineral filler in Louisiana. H. L. Lehmann and V. Adam. *Rds & Str.*, 1956, **99** (7), 117–20.—

The relative efficiencies of various fillers, for the —200 fraction, are assessed as a result of a number of lab tests, of which particle size and gradation are important. Lightweight filler, formed from pulverized lightweight aggregate, is preferred to limestone, which is superior to oyster shell dust (fine sand).

Practical tests using the lightweight filler in test sections subjected to actual traffic conditions, and with varying proportions of asphalt (5·8% and 6·3% respectively, with 5·5% as control), showed that the filler gave satisfaction, and that the stability of the mix was not affected by small variations in the bitumen content. S. L. C.

1511. Gas field—Velika Greda. V. Aksin. *Nafta (Yugoslavia)*, 1956, **7** (7), 203–5.—Research drilling, geologic structure, gas bed, and production of the Velika Greda gas field, Banat, are described. (Author's abstract.)

1512. Unique gasoline project takes shape. Anon. *Chem. Engng*, 1956, **63** (9), 134–8.—Starting next year, gilsonite, a black, solid hydrocarbon with a high resin content, will be mined in Utah by newly-developed hydraulic mining techniques. 600 tons/day will be pumped as a slurry in water 71 miles through a 6-inch pipeline to the processing plant. Processing into coke and gasoline will involve delayed coking of gilsonite and recycle oil, fractionation of vapours from the coker, cat reforming of gasoline, thermal cracking of gas oil, thermal reforming of LPG to make reformer hydrogen, and calcining the green coke. Overall yields are expected to be 50 wt% green coke, 35% gasoline (86 O.N.), and 15% 1400 B.t.u. fuel gas. The high-purity coke will be suitable for use as electrodes by the aluminium industry. D. H. A.

OILFIELD DEVELOPMENT

1513. Oil resources of West Texas (Districts 7-C and 8). M. Baude and J. Moulinier. *Rev. Inst. franç. Pétrole*, 1956, **11** (2), 163–89.—After briefly reviewing the history of oil and gas development in Texas, and giving some figures on production, reserves, pipelines, wells, etc., the geology of W. Texas is outlined and a detailed stratigraphic column given. Some of the techniques and problems of drilling in this area are discussed. Hard formations have required the use of jet bits and chert bits, while oversized drill-collars have helped to speed operations. Lost circulation is by no means rare, and where it cannot be combated water is used as the drilling fluid. Drilling has been speeded up considerably for the deeper wells; quite extensive use is being made of air or gas as the circulating fluid, and automatic drilling is being used to a considerable extent.

Secondary recovery is of great importance, and of 131 projects approved to the beginning of 1954, 111 were in District 8, 85 were water floods, 40 gas injection, and 6 mixed projects. Brief accounts are given of a few of these.

Via the Railroad Commission oil production is carefully controlled and allocated, and the quantity of gas burned has been greatly reduced. The efficiency of carbon-black production has been improved markedly.

Notes are given on a number of fields or areas, and these deal with the geology and the drilling and completion of the wells in the main. These are the Scurry Reef reservoir, Wilshire, the Spraberry trend, Breedlove field, Dora Roberts trend, and the Puckett field. G. D. H.

1514. Pembina :—3 years old and still growing. F. J. Gardner. *Oil Gas J.*, 30.7.56, **54** (65), 118.—The development of the Pembina field, Alberta, since its discovery in 1953 is reviewed. The present proved productive area is probably 400,000 acres, and its E. and W. limits are not yet precisely defined. It is a stratigraphic trap under solution gas drive, and secondary recovery projects have been started over part of the area. Oil in place is estimated at 16,000 brl/acre. Current production is *ca* 100,000 b.d. of 37° oil from 1219 producers. The main pay is Cretaceous Cardium sand, but at least 9 zones in the Cretaceous and Mississippian have production possibilities. Reservoir data are listed. C. A. F.

1515. Oil in Venezuela. J. Flandrin. *Rev. Inst. franç. Pétrole*, 1956, **11** (3), 291–325.—The first searches for oil in Venezuela began in 1884, but the discovery of Mene Grande in 1914 marked the beginning of major oil developments. Quiriquire, found in 1928, was the first find in the E. area.

The major structural units of Venezuela are briefly described, together with the palæogeographical evolution and stratigraphy of the country. The principal production is from the Tertiary, but the Cretaceous is of importance in some areas; at Mara and La Paz oil is obtained from the basement.

Examples of structural, stratigraphic, and combination traps are given, while there is a brief discussion of the techniques applied in the search for oil, and of the types of o. The main areas of production are described, with brief references to some of the fields.

In 1955 production totalled 105,461,027 m^3, of which 71,063,785 m^3 came from the Maracaibo basin. In 1954 proved oil reserves were placed at 1,737,000,000 m^3, while gas reserves were 726 $\times$ 10^9 m^3. G. D. H.

1516. India field profuse. Anon. *Oil Gas J.*, 23.7.56, **54** (64), 74.—Crude reserves of the Nahorkatiya field in Upper Assam are now estimated at over 140 million brl. 15 wells have been drilled since the field was discovered in 1953, and 3 of these were dry. Well depth averages 11,800 ft. Exploration is continuing along the Brahmaputra Valley, and shows have been reported in a wildcat on the Moran licence *ca* 60 miles from Nahorkatiya. In E. Pakistan an offset is being drilled near a high-pressure gas well found near Sylhet in 1955. C. A. F.

1517. Papua exploration shows some promise. Anon. *Petrol. Engr*, 1956, **28** (4), B90.—Exploration in Papua, where 2 companies are operating, is briefly described. 9 dry holes have so far been drilled, and excluding Kurn, where gas has been found, wells are currently being drilled at Barikewa, N. of Omati, and in the Morehead area S. of the Fly River in SW. Papua. Jungle conditions are hampering operations. C. A. F.

TRANSPORT AND STORAGE

1518. New method for emptying tank cars containing liquefied gases. P. Amalric. *Chim. et Industr.*, 1956, **75**, 333–5.—Description (sketch) of Ingersoll-Rand discharge method by use of gas pressure, generated by compressor taking suction from vapour space of receiving tank; recovery of vapour content of empty car is possible. Using 2-inch liq line, 1¼-inch gas line, 5 h.p. motor, discharge rate is 6–8 tons/hr. V. B.

1519. The largest Wear-built ship. Anon. *Mot. Ship*, July 1956, **37** (434), 116.—A description is given of the 27,400-ton M.T. *O. B. Sörensen*. It has a Doxford 7750-b.h.p. engine of the diaphragm type, and 9 centre and 18 wing tanks. Numerous photographs and diagrams show the layout of the vessel. D. K.

1520. The 26,860-ton tanker *Champs Elysées*. Anon. *Mot. Ship*, July 1956, **37** (434), 128.—This tanker has a single screw turbocharged engine which develops 11,200 b.h.p. The exhaust gas is delivered to a spanner waste-heat boiler. An unusual type of aux pump-drive is employed. D. K.

1521. Shell worldwide shipping in a nutshell. E. H. Larive. *Ingenieur, 's Grav.*, 16.3.56, **68** (11), V19–6.—Oil transport of the Royal Dutch/Shell group is carried out by group-owned

tankers and demise-, time-, or trip-chartered tankers. They vary in size, have clean or dirty tanks, or are constructed for carriage of special oil products. This system results in a high degree of flexibility. Increased oil consumption requires bigger and more efficient tankers. Max size is limited by port facilities. 3 figs, 4 tables. (Author's abstract.)

1522. Pigging and testing of pipelines, I–IV. J. W. Jones. *Fluid Handl.*, 1955, 305–6, 334–6; 1956, 32–4, 68–70.—Description and simplified diagrams of the various types of pigs or scrapers used for testing lines under construction (Pt I), initial testing of lines, whether or not fitted with permanent scraper traps (Pt II), and operational pigging of crude oil, gas, and products lines (Pt III). Details are given in each case of the procedure for pigging and hydraulic or air pressure testing. In Pt IV methods of finding lost pigs in lines under construction are discussed. Manual methods have given way to the use of pigs containing a small amount of radio-cobalt, which can be located by a Geiger counter. Procedure after location of stuck pig is described in detail. W. A. M.

1523. Better piping and vessels by cold extrusion. G. L. Hitz. *Oil Gas J.*, 16.7.56, **54** (62), 84.—The new extrusion techniques produce better prefabricated piping assemblies for plant and allow important savings in welding costs and inspection times. The Fluor Product Co are cold extruding parts at Paolo, Kansas, which had previously to be hot-forged. G. A. C.

1524. Relative interference of scatter radio systems. R. M. Ringoen. *Oil Gas J.*, 13.8.56, **54** (67), 129.—Pipeline communication systems of the future will use some form of scatter system for communication, and scatter, contrary to general belief, actually causes less overall interference and is more conservative of spectrum. This should be an important factor in determining the extent to which U.H.F. trans-horizon systems should be used in areas where spectrum congestion exists. G. A. C.

1525. Natural gas is used to displace old crude line. A. M. Hill. *Oil Gas J.*, 2.7.56, **54** (61), 93.—The displacement of crude oil from 775 miles of abandoned pipeline by use of natural gas in cold weather, when freezing might damage the pipe, is described. Safety precautions had to be taken with gas, and also when compressed air was used. Tables show costs for displacing the oil with water, gas, and air. G. A. C.

1526. Direct efficiency tests on pipeline pumps. R. G. Deering. *Oil Gas J.*, 9.7.56, **54** (62), 76.—A torque-measuring device used by Mid-Valley Pipeline Co in a complete testing procedure to test efficiency of centrifugal pumps and their drivers gives field tests closely approximating to manufacturer's shop tests. The device consists of a tool-steel flanged coupling on which are mounted strain gauges and slip rings, a silvered brush assembly, a 4-conductor cable, batteries, and a meter. G. A. C.

1527. Canada's first big inch gas pipeline. C. R. Hetherington and D. R. Pflug. *Oil Gas J.*, 20.8.56, **54** (68), 205.—The 650-mile 30-inch pipeline is due for completion by Nov 1957 at a cost of $153 million, and will gather gas from Alberta and British Columbia to Sumas, Washington. 9 compressor stations will be installed on the line to enable delivery of 660 M.M.c.f.d. G. A. C.

1528. Revised Panhandle flow formula. L. E. Hanna and J. F. Schomaker. *Oil Gas J.*, 30.7.56, **54** (65), 192.—A semi-graphical method of solving the revised Panhandle flow formula for predicting the rate of flow of gas in a pipeline is given, and examples are provided and worked out. G. A. C.

REFINERY OPERATIONS

REFINERIES AND AUXILIARY REFINERY PLANT

1529. World's largest refinery unit rising at Tide Water's Delaware site. Anon. *Oil Forum*, 1956, **10**, 90–1.—Details relevant to construction, operation, throughput, products, marine transport of the $130-million, 130,000-b.d. refinery nearing completion at Tide Water, Wilmington, Delaware. R. T.

1530. Engineering for a new petroleum refinery in Montreal. J. Alexander and E. Alzner. *Engng J., Montreal*, 1956, **39** (4), 421–30.—The Montreal refinery of Canadian Petrofina Ltd, which went on stream in Sept 1955, not only incorporates the latest process and control techniques, but also involves many interesting engineering features and offsite facilities.

Particular attention is paid to the cat cracking unit, which employs gravitational flow and has a main dia of 24 ft and towers rising to nearly 300 ft, the tallest in Canada. It is remarkable that this huge unit was shop pre-assembled rather than field-erected.

The article also gives brief details of the automatic control system; services and facilities; effluent; storage and marketing; and general conditions. 13 figs. M. P. T.

1531. Breaking into Canadian market with blitz tactics. Anon. *Oil Forum*, 1956, **10**, 141–5.—Spectacular rate of growth of Canadian Petrofina Ltd is described. The 20,000-b.d. refinery near Montreal treats domestic and imported crudes. Close integration of processes—representing latest advances in petroleum conversion—using only 6 intermediate storage tanks during operations, allows production of gasoline pool >98 leaded research O.N. A stylized flow diagram shows unique flexibility. R. T.

1532. Daurah's power plant makes refinery self-sufficient. H. B. Sumner. *Oil Forum*, 1956, **10**, 122–3.—Layout and mechanical operation of the self-sufficient installation designed to start the refinery plant from cold are described. R. T.

1533. Daurah refinery. A quarter-century old Iraqi aspiration now achieved. B. O. Lisle. *Oil Forum*, 1956, **10**, 47–8.—After prolonged negotiations (1923–51), construction—started in 1953—culminated in charging the Daurah unit in 1955 with crude. After preliminary trials the plant was put on stream to produce a variety of top products, motor gasoline, kerosine (lamp oil), gas, diesel, and fuel oils to meet Iraq's increasing demands. R. T.

1534. Iraqi planning and capital, Western engineering. H. E. 'Ata'Amin. *Oil Forum*, 1956, **10**, 49–50.—The Daurah 24,000 b.d. refinery—international in conception—is situated near Baghdad for economic reasons. This first unit of the new industrial era utilizes fully national resources. Most modern facilities ensure ideal working conditions. R. T.

1535. Daurah's advanced design reduces operational costs. M. Al-Naqib. *Oil Forum*, 1956, **10**, 51–4.—In Daurah refinery described, operational costs are reduced compared with conventional plants. Crude dist, visbreaking, cracking, reforming, and vac-flashing are carried out in a single integrated plant. Economies include lower capital cost, reduced labour costs—due to automatic instrumentation—saving in fuel, elec power, steam, and water. R. T.

1536. Own refinery keystone in Iraq economy. T. Rif'at. *Oil Forum*, 1956, **10**, 55–7.—The 24,000-b.s.d. Daurah refinery is designed to meet 1956–57 domestic demands for petroleum products. A test run in Apr 1955, on a throughput of 27,000 b.s.d., or 112·5% of design capacity, gave excellent results. R. T.

1537. Here's real preventive maintenance. C. C. Carmine. *Oil Gas J.*, 16.7.56, **54** (63), 96.—Avon, California, refinery of Tidewater Oil Co considers 8 factors in preventive main-

tenance. These include design and material controls, operating procedures, records, extent of programme, accounting system, organization and procedures, report and quality of personnel. The refinery concerned has a capacity of 111,000 b.d., running 25 light and heavy crudes on various processes. G. A. C.

1538. Carbon, a chemical engineering material. J. Parisot and J. Clédat. *Rev. Inst. franç. Pétrole*, 1956, **11**, 831–48.—Physical and chem properties (thermal conductivity, coeff of expansion, mechanical strength, sp. ht., chemical resistance) of graphite are discussed and tabulated; a brief description of impregnation procedures is given. Examples of carbon equipment (illustrated) include piping, pumps, condensers, heat exchangers, tube bundles, absorption towers. Tabulation of principal fields of chem industry where constructional carbon is of value on account of its corrosion-resistance. V. B.

1539. Simplified combustion calculations. D. Kist and R. Frumerman. *Chem. Engng*, 1956, **63** (7), 179–84.—A series of charts is given which simplifies combustion problems involving heat and material balances where the fuel is natural gas, fuel oil, or kerosine. The use of the charts is illustrated by worked examples. D. H. A.

1540. Experience with rubber diaphragm type gas compressors. I. Sterkman. *Ingenieur, 's Grav.*, 3.2.56, **68** (5), Ch5–8.—After reviewing the types of compressor that can be used where oil–gas contact is undesirable, the advantages of compressors with steel or rubber diaphragms are discussed. A description is given of a number of small compressors with synthetic rubber diaphragms built and tested by the Shell lab in Amsterdam. An encouraging amount of success has been obtained. 3 figs. G. F. T. C.

1541. Ridding process waters and caustic solutions of sulphides. A. G. Smith. *Oil Gas J.*, 9.7.56, **54** (62), 95.—An air-oxidn process has been developed and put into use at the Wilmington refinery of the Shell Oil Co.

The process involves conversion of the sulphides to thiosulphates at elevated temp and pressures, and enables sulphide-bearing waters to be disposed of without objectionable pollution of the atm or surface waters. G. A. C.

1542. Biological oxidation of phenolic waste water. A. D. McRae, W. K. Ross, and A. A. Sheppard. *Oil Gas J.*, 20.8.56, **54** (68), 223.—The equipment and process is described for destroying low concn of phenols in aq soln produced by the phenol plant and from cat-cracker sour water and other wash waters at Sarnia. Batches of bacteria are bred in 45-gal drums in the lab, and this source used to start cultures in the sump of the 30-ft dia trickling filter where the waters are treated. A flow diagram is given. G. A. C.

1543. Pressure loss for liquid flow in pipes. H. A. Smallwood. *Oil Gas J.*, 23.7.56, **54** (64), 93.—A chart is given from which pressure-drop calculations can be made through a wide range of visc, flow rates, and pipe sizes from 1 to 30 inches. The region of flow—turbulent, transition, or laminar—can also be determined. G. A. C.

1544. Computers provide efficient control system. K. E. Frye and K. L. Shull. *Oil Gas J.*, 6.8.56, **54** (66), 80.—The use of conventional and special type computers by Standard Oil Co for gasoline blending operations is described. Savings in manpower, increased accuracy, and speed of making blending calculations are claimed, and quality problems foreseen, thus enabling corrective action to be taken. G. A. C.

DISTILLATION

1545. Fractional distillation. H. H. M. Jones. *Chem. Proc. Eng.*, 1956, **37**, 301–4.—Review, under the heads of: lab, vapour–liq equilibrium, calculations, bubble-cap plates, packed columns, perforated plates, azeotropic and extractive dist, general. 109 refs. V. B.

1546. Perforated trays. L. Friend and E. J. Lemieux. *Oil Gas J.*, 23.7.56, **54** (64), 88.—A report is presented on 81 perforated tray towers, 61 of which have been in operation for at least 6 months. Costs vary from 10 to 28% less than those for bubble trays in the same process, with equal or better performance. G. A. C.

1547. Efficiency of packed columns for extractive distillation. F. H. Garner, S. R. M. Ellis, and W. H. Granville. *J. Inst. Petrol.*, May 1956, **42** (389), 148–54.—The authors have investigated the factors which influence the HETP of packings in the binary system methyl*cyclo*hexane–toluene and the extractive dist system methyl*cyclo*hexane–toluene–furfural. It is concluded that the HETP is a minimum for binary and extractive dist at the loading velocity. Above this velocity the order of the (HETP/*Ma*)(*Gm*/*Lm*) value is greatly effected by the amount of solvent in extractive dist, but below the loading velocity the (HETP/*Ma*)(*Gm*/*Lm*) value is independent of solvent concn. Experimental procedure and results are given. 15 refs. C. B.

1548. Twenty-stage molecular distillation unit. F. W. Melpolder, T. A. Washall, and J. A. Alexander. *Analyt. Chem.*, 1955, **27**, 974–7.—A 20-stage countercurrent molecular still has been developed for the dist of high-boiling samples. The use of the still is expected to permit a more complete analysis of heavy petroleum products. The still, with a capacity of 1500 ml, consists of one large and 19 small still pots connected in series. The unit can be operated as an equilibrium-type still for samples less than 260 ml and as a batch dist unit for larger volumes.

Automatic safety controls allow the still to operate unattended. The still has been used to prepare narrow boiling fractions from lub oil stocks. J. S.

1549. Heat transfer to boiling binary liquid mixtures. A. S. Vos. *Igenieur, 's Grav.*, 27.4.56, **68** (17), C9–3.—Heat-flux as a function of the temp difference between heating surface and boiling liq mixtures has been investigated throughout the whole range of convection until the max of nucleate boiling. In some mixtures a considerably higher max heat-flux (approx 3½×) than with water has been obtained, alternatively the same heat-flux as for water is obtained at a lower surface temp. At the optimum for max heat-flux the size of the bubbles is very small, and a preliminary explanation of this phenomenon is attempted. The liq was kept at b.p. in the apparatus and boiling induced by means of a Pt wire heater. E and I of the heater wire allowed heat input and surface temp to be determined. It was found that the liq composition corresponding to max heat-flux is independent of the heater wire metal, the amplitude of the max depends on it, and is highest for a rough oxidized nichrome wire. 4 figs, 13 refs. G. F. T. C.

ABSORPTION AND ADSORPTION

1550. New Reynosa absorption plant designed for huge capacity. J. C. Reidel. *Oil Gas J.*, 6.8.56, **54** (66), 89.—The Reynosa plant belonging to Petroleos Mexicano is described, which handles 300 M.M. cu. ft/day of gas, to produce liq to blend with other fractions for regular and premium grade gasolines, kerosine, and various specifications of fuel oils. G. A. C.

1551. A new vapour recompression method for oil–gas separation. Anon. *Petrol. Times*, 20.7.56, **60** (1538), 607.—A new let-down and gas recovery scheme is described, devised by Head Wrightson Processes Ltd, for separation of hydrocarbon gases from virgin crude oil. Oil–gas separators are arranged in series and operate at successively decreasing pressure levels, the gas vent from each stage being compressed and returned to the preceding high pressure stage. G. A. C.

SOLVENT EXTRACTION AND DEWAXING

1552. Study of hydrocarbon separation by liquid–liquid extraction with dimethylformamide. J. Durandet and Y. L. Glasel. *Rev. Inst. franç. Pétrole*, 1956, **11**, 811–17.—Equilibria are detd at 0° and 20° C for dimethylformamide/*n*-heptane/toluene and at 20° C for DMF/*n*-heptane/*cyclo*hexane, using apparatus and technique previously employed (*cf* Abs. **1615**, 1954). Considered that DMF is suitable solvent for separation of light hydrocarbons; it is non-corrosive, stable (decomp 350° C), but very hygroscopic and slightly toxic; low v.p. (3·7 mm/25° C) minimizes latter effect and permits relatively safe use. V. B.

CRACKING

1553. Cat reactor design problems. II. T. E. Corrigan and W. C. Mills. *Chem. Engng*, 1956, **63** (8), 221–6.—A detailed step-by-step procedure for the solution of problems in the design of adiabatic reactors is given and is illustrated by a worked example. D. H. A.

1554. Oil cracking to peak production in gas coke plant, Berlin-Mariendorf. H. Bausch. *Erdöl u. Kohle*, 1956, **9**, 90–3.—Procedure and economics of peak gas production from water gas and oil-cracked gas with cal. val. 4200 k.Cal/m³ are discussed. R. T.

1555. Insulation critical factor in Platforming unit. A. A. Niehenke. *Oil Forum*, 1956, **10**, 244–5.—Insulation to maintain temp is of crit importance in new 10,000-b.d. Platforming unit at Cleves, Ohio. Details are given of materials and quantities for insulating cat reforming units for upgrading heavier low octane portion of gasoline to high octane. R. T.

1556. Influence of metal oxide additions on properties of aluminium silicate cracking catalysts. K. A. Fischer and G. Brandes. *Erdöl u. Kohle*, 1956, **9**, 81–6.—Reaction mechanism and cat structure are investigated. At const aluminium silicate cat acidity metal oxide addn increases cracking intensity, *i.e.* in a passage the transformed amount of oil introduced with greater surface, and with increasing acidity on const surface. Surface and acidity are controlled in cat production. No increase in cracking intensity is to be expected by introducing metal oxides into the formed aluminium silicate cat when its characteristic acidity remains unaltered. The Al-ion—co-ordinatively associating a tetravalent mobile proton—is the effective cat. Cat selectivity is influenced by the metal oxide addn. Oxides of the nobler metals added to the cat surface are less selective than those of base metals. Increasing Cr_2O_3 concn in the range investigated up to 0·36 wt% raises the combustion rate of the coke formed in the reaction during regeneration. The CO_2–CO ratio in the combustion gases is not affected thereby. The usual commercial concn of 0·14 wt% Cr_2O_3 in Cr bead cat represents a compromise between 3 factors: good selectivity with adequate activity and good regenerative ability. Desulphiding properties of aluminium silicate cat are not influenced by Cr_2O_3 cont in the quantities discussed. 14 refs. R. T.

1557. First Reformer goes on stream. Anon. *Oil Gas J.*, 13.8.56, **54** (67), 106.—The Reformer unit of Aurora Gasoline Co at Detroit is now on stream and is described. The unit processes 5500 b.d. of fresh feed with 1500 b.d. recycle to yield 102 octane gasoline product. A flow diagram is given. G. A. C.

1558. Another platinum reforming process available. Anon. *Oil Forum*, 1956, **10**, 212–13.—Standard Oil Co (New Jersey) makes available its newest cat reforming process "Powerforming," featuring new type Pt cat, easily preserved for indefinite use by new regenerating technique. R. T.

1559. Computers optimize gas-plant operation. E. V. Merrick. *Oil Gas J.*, 6.8.56, **54** (66), 75.—Standard Oil Co employed an electronic computer to determine optimum operating conditions for the cat-reformer gas plant. Data obtained helped in determining design conditions for other gas plants and in making alterations to the plant studied. G. A. C.

1560. Explanation of the reaction mechanism of gaseous and liquid hydrocarbon cracking to produce industrial gases. M. Gerhold. *Erdöl u. Kohle*, 1956, **9**, 24–9, 93–8, 157–62, 228–33.—Pt I. Thermal decomp of gaseous and liq hydrocarbons without cat. Pure thermal hydrocarbon cracking proceeds primarily by rupture of the C–C bond. Physical and chem composition of charged material controls occurrence of *sec* reactions. Selective cracking results only with pure hydrocarbons and by observing stringent operating conditions. In obtaining reaction products of const composition in pyrolysis of hydrocarbon mixtures avoidance of *sec* reactions, *e.g.* at high temp, is difficult. However, using selective surface-active substances, chain splitting at lower temp, at definite mol positions, *e.g.* the middle, is possible, also control of yield-diminishing *sec* reactions. 40 refs.

Pt II. Thermal-cat decomposition of gaseous and liq hydrocarbons. The influence of the observed cracking degree or smaller cyclizing or dehydrogenation reaction relative to the total reaction, on the total conversion, depends on the C–H ratio of the added material and the physical test conditions thereby determined. Influence of chem composition on yield of olefinic gas cleavage is analogous to that in thermal cracking. Increased H partial pressure lowers yield-reducing hydrogenation reactions. Tech execution of hydrocarbon cracking to produce olefin-rich gas is either discontinuous where C separating on the cat is burned periodically, delivering cracking heat required, or continuous, utilizing circulating cat heat carriers which are freed from C and tar externally. Powdered cat may be used. 37 refs.

Pt III. Cracking of gaseous and liq hydrocarbons in presence of steam. Tests on the reaction mechanism of thermal and thermal-cat cracking show the impossibility of obtaining cracked gas of similar composition to town or synthesis gas by altering physical test conditions only. However, this is attained by superposing an oxidn process to the cracking, *i.e.* by partly or wholly transforming the cracked products of the primary decomp with oxidizing substances, *e.g.* air, steam, etc. Test methods used hitherto to alter gas yield or composition at will have not succeeded. Experimental tests and theoretical considerations on the reaction mechanism of the conversion show that separation of the reaction phases produces essential improvement in gas yield, heat endurance of the total conversion, and reaction control. By the tech measures described differences in composition can be adjusted without yield diminution, and end gas properties altered. 11 refs.

Pt IV. Cracking of gaseous and liq hydrocarbons in presence of oxygen or air, also of air and steam. Inability to control completely reactions with different velocities renders arbitrary alteration of gas composition in steam or steam–air cracking unsuccessful. Studies of the reaction mechanism of the conversion show that in cat cracking—by separating the reaction phases and activating the main reaction with oxidic or bifunctional cat—essential improvements in gas composition and control of the reaction are obtained. A reproducible performance of steam–air cracking occurs only when the proportion of air cracking to total conversion is essentially below the calc val. With suitable reaction conditions in presence of activated cat the combustion reaction of primary cracked fragments activates essentially the endothermic cracking reaction or conversion of primary cracked fragments with steam. It seems adequately proved that the reaction course of high-mol hydrocarbon conversion with steam, air, or O_2 proceeds always over primary rupture of the C–C bond, and it is especially important in all conversions to let the primary cracking process run out under optimum conditions. The proposed tech measures permit adjusting differences in composition of the added material, and make possible arbitrary change in composition of the cracked gases. This was not possible with former conventional methods. 16 refs. R. T.

1561. How to clean heat-exchange equipment. J. S. Clarke. *Oil Gas J.*, 23.7.56, **54** (64), 76.—This is Pt 2 of a series of 6 on the maintenance of cat cracking units. 3 common methods are described, and include chemical, mechanical, and hydroblast. The chemical methods involve the use of hydrochloric or sulphuric acids with wetting agents and inhibitors; mechanical cleaning involves air blasts, water and steam jets, sand blast, rods, and drills. In hydroblast cleaning high velocity streams of water and sand are employed. G. A. C.

1562. Welding on catalytic-cracking units during operation. J. S. Clarke. *Oil Gas J.*, 2.7.56, **54** (61), 90.—This is the first of 6 articles on maintenance of cat cracking units, and details safe procedures for preparation and actual welding of plant in operation. G. A. C.

1563. Here's how heat-insulating linings are maintained. J. S. Clarke. *Oil Gas J.*, 13.8.56, **54** (67), 118.—This is Pt 3 of a series of 6 on the maintenance of cat cracking units, and details are given on installation of monolithic heat-insulating linings and steel-mesh-reinforced refractory wear plates. Inspection and repair of these linings are also discussed. G. A. C.

1564. Making ethylene. 4. Compression and pretreatment of pyrolysis product. H. C. Schutt and S. B. Zdonik. *Oil Gas J.*, 25.6.56, **54** (60), 92.—A multi-stage compression system for 500 p.s.i.g. is described; choice of compressor, means of eliminating condensate, removal of acetylene, cat reactivation, adsorbent selection, and gas cooling are considered. A flow diagram and various tables are given. G. A. C.

ISOMERIZATION

1565. High octanes at low cost. Anon. *Oil Gas J.*, 23.7.56, **54** (64), 96.—The Penex process developed by Universal Oil Products Co for isomerizing normal pentane or hexane is described, and advantages outlined when the process is used in conjunction with Platforming. Tables show yields and costs. G. A. C.

1566. Penex plus Platforming: an economical path to high octane. D. H. Belden. *Petrol. Times*, 31.8.56, **60** (1541), 776.—The newly-developed Universal Oil Products Co's "Penex" process is described for up-grading pentane fractions.

This involves continuous cat isomerization of normal pentane in the presence of hydrogen without degeneration, but with recycle to achieve ultimate conversion; yield of isomerized product is *ca* 99·5%. The process can improve yield of pool gasoline by 6–10%. G. A. C.

CHEMICAL AND PHYSICAL REFINING

1567. Why diethanolamine breaks down in gas treating service. L. D. Polderman and A. B. Steele. *Oil Gas J.*, 30.7.56, **54** (65), 206.—Accumulation of heat-stable diethanolamine salts of certain organic acids, such as formic and acetic, and of complex inorganic acids, such as hydroferro-cyanic acid, and conversion of diethenolamine to linear polycarbamides reduces capacity of the scrubber fluid.

Data are presented which show the necessity of revivifying rich diethanolamine soln at the lowest optimum temp. G. A. C.

1568. Analysis of low-temperature separation plants. H. E. Stamm, D. G. McCarty, D. B. Aller, and C. S. Moore. *J. Petrol. Tech.*, 1956, **8** (5), 25–9.—A method for calculating the performance of low-temp condensate separation plants is described, together with the equipment upon which a series of tests were run. Close agreement between calculated and observed plant recoveries was found, and it was concluded that taking due precautions and making lab tests to provide adequate experimental checks can give predictions which are of reasonable accuracy from an engineering standpoint.

Calculations using the average inlet gas composition indicated an increase in recovery by decreasing the temp from +3° to −30° F. This increase of 3·6 brl/M.M.c.f. compared with 1·6 brl/M.M.c.f. observed. G. D. H.

1569. Liquid–gas contacting. R. E. Vener. *Chem. Engng*, 1956, **63** (8), 175–206.—A comprehensive review is presented of current liq–gas contacting operations and the theoretical principles on which they are based. These operations include chemical reactions, dist, absorption and desorption, vaporization and condensation, direct contact heat transfer, gas scrubbing, humidification and dehumidification, vacuum production, mixing, and fluid transport. The commercial equipment available for these operations is described and includes tray columns, packed columns, spray units, jets, vaporizers, and mechanical contactors. D. H. A.

1570. Acid treatment of shale gasoline. Pt III. Effects of some treatment conditions. G. E. Mapstone and J. A. Grosberg. *J. Inst. Petrol.*, June 1956, **42** (390), 168–70.—The effect of treatment of the gasoline with 70% sulphuric acid at 100° F is investigated and the results compared with cold 93% acid treatment. The gasoline is found to be more stable, with hot acid treating. Tar acids are readily extractible with the hot acid, and may cause loss of treating efficiency if they are present in the gasoline above 0·2%. Plant scale work is described. 7 refs are included. C. B.

SPECIAL PROCESSES

1571. Carbon monoxide conversion on alkalysed activated carbon. Communication 2. P. Royen and F. Ehrhard. *Erdöl u. Kohle*, 1956, **9**, 19–24.—Tests are described on CO conversion on activated C (Supersorbon Tiv) impregnated with K.COOH, $K_2C_2O_4.H_2O$, KCl, KF, and alkali carbonate treated with H_2S gas contacts. A test example is given. The effect of H_2O (-OH ions) is discussed. It is shown that the CO conversion occurs through intermediate alkali formate. R. T.

1572. Hardening and heat-treatment oils for large hardening installations. A. Sponheuer. *Erdöl u. Kohle*, 1956, **9**, 30–4.—In the limited tests described the relative effects of oil and water quenching on the tensile properties of large sections are investigated. Extended tests on further steel brands and higher quenching temp are required. A connexion between the Ag-ball curve and the effect of the quenching medium on surface hardness is necessary. A relationship is required between Ag-ball curves and quenching effect on 200-mm-dia forgings, the effect of the different oils used shows no difference in the core zone. A gap exists between H_2O, a harsh, and oil, a milder quenching medium. Crit cases are referred back to H_2O heat treatment, although oil gives smaller deformation and stresses. Special oils bridge over this gap for smaller dimensions. Up to *ca* 50 mm depth special oils tested have the same effect as H_2O on the core of large forgings. Quenching media are sought to effect increased heat conduction in the interior of large sections. The limit of this conduction lies in the steel itself, and may be increased by using alloying elements. R. T.

1573. Manufacture of hydrogen-containing gas and of synthesis gas from petroleum products. O. Goepfert. *Rev. Inst. franç. Pétrole*, 1956, **11**, 797–810.—A review, with flow sketches, of the following processes: thermal (carburetted water gas, Hall, Jones), cat externally heated (Hercules Powder, ONIA), cat internally heated (Fauser–Montecatini, cyclic cat reforming, Segas, ONIA–GEGI). V. B.

1574. Increase of valuable product yield in coking by slack wax and pitch addition to coking coal. W. Fuchs and C. Gewers. *Erdöl u. Kohle*, 1956, **9**, 87–90.—Addn of neutral oil slack wax and of stearin pitch to coking coal increases the valuable product yields considerably. Addn of tar pitch does not produce an increase. Introduction of mixtures containing neutral oil slack wax and tar pitch or stearin pitch and tar pitch leads to higher valuable product yields, as expected. Mixtures

of neutral oil slack wax and stearin pitch also delivered greatly increased valuable material yields, which, however, with the exception of ethylene yield, were not higher, as expected from experience with the individual materials. R. T.

1575. Rectisol process for purifying pressure gases. W. Herbert. *Erdöl u. Kohle*, 1956, **9**, 77–81.—Conventional processes are discussed. CH_3OH dissolves at −30° C 20 times, and at −60° C 75 times as much CO_2 as H_2O does at 25° C. Working at −30° to −60° C with CH_3OH incurs $\frac{1}{10}$ or less pressure water wash circulation. Gases to be treated need not be dry, since before passing 0° C limit CH_3OH is sprayed in to prevent ice separation. Practically all gas impurities in tech fuel gases are more sol than CO_2 at temp level −30° to −60° C. These considerations are the basis of the new process—described and illustrated—carried out in one operation at Sasolburg S.A. for total purification of pressure gases. Power costs—in spite of refrigerating machines—are < those of a pressure water washer. The purest synthesis gases are produced for the Fischer–Tropsch process. R. T.

PRODUCTS

ANALYSIS AND TESTING

1576. Test method for extreme-pressure lubricants, using French hypoid axles. J. Thiery, R. Ducos, and F. Suslenschi. *Rev. Inst. franç. Pétrole*, 1956, **11**, 849–59.—Procedure developed (full details) for test of CRC L19 type using Simca equipment. Experimental work on 3 oils, A good EP oil, B pure mineral oil, C blend 10% A, 90% B; photographs of results are given. Car provided with equipment recording axle oil temp, engine speed, throttle opening. Rise in axle oil temp (*e.g.* A 89° C, B 117° C, C 99° C) is found to be a more sensitive criterion of oil quality than surface examination of gears. V. B.

1577. Evaluation of dielectric strength gauges for transformer oil. K. H. Weber and R. B. Kaufman. *Trans. Amer. Inst. Elect. Eng.*, 1956, Paper No. 745. 11 pp.—Comparative trials were made with a multiple test cell incorporating 4 electrode assemblies: ASTM D1117, 0·1-inch gap; Rogowski, 0·08-inch gap (giving uniform field); German VDE 0370/1936, 0·08-inch; point to barrier, 0·2-inch gap. Cell capacity 5 l, oil stirred, voltage rise 0·5 kV/sec, 10 values obtained for each gap. Tests on over 300 oil samples. Results indicate that point to barrier gap is most insensitive to oil quality, best sensitivity is given by sphere (VDE) gap, followed by Rogowski and then by ASTM electrodes. Most tests (using oils from operating equipment) done with VDE and ASTM electrodes, the latter show decreasing differentiation between oils as breakdown strength increases. Description of a new type test cell, using VDE electrodes and stirrer; no loss of sensitivity results from increasing voltage rise rate to the 3 kV/sec used in ASTM procedure. V. B.

1578. Application of the logarithmic sector to quantitative spectrographic analysis of petroleum ash residues. E. B. Childs and J. A. Kanchann. *Analyt. Chem.*, 1955, **27**, 222–5.—This method of analysis can be applied to any powder or sample of ash residue from deposits, sludges, used oils, greases, and cracking cat. It provides a rapid quantitative procedure for the analysis of such samples requiring somewhat less precise results than are given by chemical analysis. The method obviates the need for an expensive densitometer. Analytical procedures, data, and results on 13 different samples are given. The average standard deviation is 30%. Working time/sample is *ca* 75 minutes for ashing and quantitative determination of 11 elements, in contrast to *ca* 2 hr for the densitometric method or 24 hr for the chemical method. J. S.

1579. Purification, purity, and freezing points of 64 American Petroleum Institute Standard and Research Hydrocarbons. A. J. Streiff, A. R. Hulme, P. A. Cowie, N. C. Krouskop, and F. D. Rossini. *Analyt. Chem.*, 1955, **27**, 411–15.—This paper describes the purification and determination of purity and freezing points of 64 hydrocarbons, including 11 paraffins, 3 alkyl-*cyclo*propanes, 1 alkyl-*cyclo*pentane, 4 alkyl-*cyclo*hexones, 24 mono-olefins, 12-alkyl-benzenes, 3 di*cyclo*paraffins, 3 dinuclear aromatics, 1 *cyclo*paraffin-aromatic, and 2 olefin-*cyclo*paraffins. Typical dist are shown graphically and represent cases where the purest material is respectively largely in the forepart of the dist, the middle of the dist, or the after part of the dist. Refractive index, b.p., freezing point, and purity are plotted as a function of the vol of hydrocarbon part of the dist. Values for freezing points and cryoscopic constants are also reported. J. S.

1580. Annual reviews—petroleum. H. Levin. *Analyt. Chem.*, 1955, **27**, 599–606.—This review of advances in analysis in the field of petroleum covers the literature during 1954. J. S.

1581. Lubricating oil reveals wear in pipeline compressors. J. L. Wilson and S. R. Sawyer. *Oil Gas J.*, 10.7.56, **54** (63), 108.—A progress report on an American Gas Assoc Research Project NB-16 shows that the use of spectrographic analysis of compressor lub oil promises to be an important tool in the detection of part failures and measuring wear without removing the engines from service. Tables give spectrographic analyses showing normal engine operation and ring and cyl wear, and where failure has occurred. G. A. C.

1582. Amperometric method for mercaptan sulphur in hydrocarbons. M. D. Grimes, J. E. Puckett, B. J. Newby, and B. J. Heinrick. *Analyt. Chem.*, 1955, **27**, 152–4.—The amperometric titration of total mercaptan sulphur with silver nitrate has been applied to synthetic blends of mercaptans in hydrocarbons. The average deviation from the true value was 1 p.p.m. for liq hydrocarbons containing mercaptan sulphur in the range of 0–100 p.p.m. and 3 p.p.m. for gaseous hydrocarbons containing mercaptan sulphur in the range 0–400 p.p.m. Organic sulphides, disulphides, thiophenes, and TEL do not interfere, and free sulphur in amounts of less than 10 p.p.m. does not interfere. Small amounts of chloride and bromide do not interfere, but cyanides and other ions such as iodides and sulphides which form insoluble silver salts in ammoniacal soln do interfere.

The apparatus is simple, compact, and portable. The amperometric titration can be completed in less than 10 minutes and is especially suitable for use in routine determinations of total mercaptan sulphur in hydrocarbons. J. S.

1583. Separation of sulphur compounds from petroleum. C. J. Thompson, H. J. Coleman, H. T. Rall, and H. M. Smith. *Analyt. Chem.*, 1955, **27**, 175–85.—This paper reviews work on the newer methods of separation of sulphur cpds in petroleum, particularly as applied by API Research Project A. Discussed in this review are physical methods, such as dist, adsorption, and thermal diffusion; and chemical methods, such as complex formations. Thermal diffusion, one of the more recently developed techniques, is discussed with its applications to the separation of sulphur cpds and the constituents of crude oil. A list of 43 sulphur cpds found in Wasson, Texas, crude oil is given. These were concentrated from the crude oil by one or more of the above methods and their identification established by i.r. absorption spectra or mass spectrometry. J. S.

1584. Determination of sulphur in volatile hydrocarbons by a lamp-conductometric method. E. R. Quiran. *Analyt. Chem.*, 1955, **27**, 274–7.—A conductometric method has been developed for the determination of sulphur in the products of combustion resulting from lamp burning of volatile hydro-

carbons. It is simpler than conventional procedures, and has eliminated many of the weaknesses encountered with turbidimetric, nephelometric, volumetric, and gravimetric methods. A new type of absorber has been designed which permits the determination to be completed in one vessel. Means are provided for eliminating errors caused by temp fluctuations and dissolved carbon dioxide. The method has been found suitable for all ranges of sulphur concn. The presence of aldehydes, halogens, nitrogen, and other acid-forming substances will interfere. J. S.

1585. Oxyhydrogen burner for determination of sulphur in drip oils. L. [illegible]natelli. *Analyt. Chem.*, 1955, **27**, 266–9.—The determination of small concn of sulphur in drip oils by conventional combustion methods is unsatisfactory. This paper presents the results of an investigation undertaken to determine the feasibility of using an oxyhydrogen burner as a means of burning the sample. The drip off is aspirated through the burner directly into the oxyhydrogen flame. Products of combustion are absorbed in hydrogen peroxide soln and the sulphur is determined as barium sulphate. Under the conditions employed a burning rate of 24 ml/hr is maintained. This rapid burning rate favours the analysis of samples containing low concn of sulphur as large samples can be burned in a relatively short time. The apparatus is suited to the determination of sulphur in a variety of petroleum liq. Analysis of samples containing from 0·006 to 0·112% sulphur showed standard deviations of 0·001 to ±0·004%. The analysis of a solution of elemental sulphur by this method showed that the apparatus is applicable for the determination of elemental sulphur in hydrocarbon mixtures. With minor modifications the method may be extended to the determination of halogens in a variety of petroleum samples. J. S.

1586. Distillation micromethods for the analysis of petroleum. A. R. Javes, C. Liddell, and W. H. Thomas. *Analyt. Chem.*, 1955, **27**, 991–6.—This paper describes a still which has been developed for the analysis of small quantities of petroleum products. Results have been obtained on 0·8- or 1-ml samples of oil which are in agreement with those by the corresponding methods IP 24, IP 123, or ASTM-D86 at atm pressure or ASTM-D1160 under vacuum. The use of a microcolumn for the fractionation of a crude oil using *ca* 5 ml of sample shows that the residues and dist fractions compare with those given by 14-plate column dist equipment using several l of crude. The repeatability of the micromethod is *ca* ⅓ that of the micro test. J. S.

1587. A high rate of shear rotational viscometer. E. M. Barber, J. R. Muenger, and F. J. Villforth. *Analyt. Chem.*, 1955, **27**, 425–9.—A high rate of shear rotational viscometer has been developed for studying the shear behaviour of non-Newtonian materials. The paper describes information on the design, construction, and typical operation of a rotational viscometer for operation at shear rates up to *ca* 1,000,000 reciprocal sec. Temp effects due to high rate of shear have been satisfactorily controlled by using thin films, and making equal heat paths from the film through the outer and inner working cyl. Calibration data of the viscometer is also presented, together with figures on several mineral oil–polymer blends, including 2 tested by another investigator, showing agreement for the 2 investigations. J. S.

1588. Determination of hydrocarbons in hydrogen by a palladium tube—mass spectrometer method. R. A. Brown, H. B. Ogburn, F. W. Melpolder, and W. S. Young. *Analyt. Chem.*, 1955, **27**, 237–9.—A convenient method for concentrating hydrocarbons in hydrogen-rich samples by pumping the hydrogen through a palladium tube is described. By combining this procedure with mass spectrometric methods 0–3% hydrocarbons can be determined individually with an error of 0·1% and a repeatability of 0·05%. 20 minutes are required to obtain a hydrocarbon concn. J. S.

1589. For ultra-violet absorption spectra of unsaturated and aromatic hydrocarbons. L. C. Jones, Jr., and L. W. Taylor. *Analyt. Chem.*, 1955, **27**, 228–37.—With the development of recording photo-electric spectrometers measurements of analytical accuracy in the far u.v. region (1700–2100 A) have been made possible. The spectra of 69 pure hydrocarbons reported in this paper have been measured either in the vapour or soln state with a recording vacuum spectrometer, employing a 1-m concave grating and a photo-electric detector. Experimental methods are described, and spectra of representative paraffins, naphthenes, cyclic and non-cyclic mono-olefins, allenes, conjugated and non-conjugated diolefins, acetylenes, benzenes, naphthalenes, and polycyclic catacondensed aromatics are presented. Useful correlations between the spectra and structure of these hydrocarbons are discussed. It is concluded that for u.v. absorption, spectroscopy is a promising new tool for the analyst. J. S.

1590. Spectrographic analysis of petroleum products and related materials. L. L. Gent, C. P. Miller, and R. C. Pomatti. *Analyt. Chem.*, 1955, **27**, 15–17.—A new method for the preparation of samples in the spectrographic determination of relatively larger amounts of metals and phosphorus in various materials is described. It is applicable for the analysis of used and unused lub oils, additive concn, greases, sludges, and deposits. A small amount of the sample is burned on a relatively large bed of graphite powder containing copper oxide as additional buffer and internal standard. After mixing, portions of this powder are tamped into a shallow cratered graphite electrode and arced for 60 sec in a direct current arc. Analytical curves are constructed using the same technique on samples of known composition. J. S.

1591. Mass spectrometric analysis of high molecular weight saturated hydrocarbons. R. J. Clerc, A. Hood, and M. J. O'Neal. *Analyt. Chem.*, 1955, **27**, 868–75.—A mass spectrometric method has been developed for hydrocarbon type analysis of high boiling predominantly saturated petroleum fractions. Following hydrocarbon types are determined: alkanes, non-condensed *cyclo*alkanes, condensed *cyclo*alkanes, mono-aromatic, and naphthalene derivatives.

The relative abundance of *cyclo*pentyl and *cyclo*hexyl rings as free structures is estimated. The method is based on the mass spectra of over 60 pure hydrocarbons and several narrow hydrocarbon-type concentrates. Average spectra of all cpds of each of several hydrocarbon types were used to formulate the calculation matrix. It was shown that pure cpds of a single hydrocarbon type could be analysed with an accuracy of *ca* 95%. J. S.

1592. Analysis of automobile exhaust gases by mass spectrometry. J. K. Walker and C. L. O'Hara. *Analyt. Chem.*, 1955, **27**, 825–8.—Mass spectrometer techniques have been utilized as a means for the analysis of automobile exhaust gases. Results of the investigation indicate the importance of proper sampling procedures and these are described. Total water content of the gas was used as a measure of representative sampling.

By continuous recording of mass spectra at various engine speeds, changes in exhaust gas composition could be demonstrated. The hydrocarbon and air content of exhaust gases approach a steady state at high engine speeds, while the oxides of nitrogen increase proportionately with engine speed and temp. J. S.

1593. Identification of petroleum refinery wastes in surface waters. A. A. Rosen and F. M. Middleton. *Analyt. Chem.*, 1955, **27**, 790–4.—The most significant pollution effect of petroleum refinery wastes in receiving waters is the production of odours and tastes, and for this reason there is a need for subjective methods of identification comparable to odour judgments. In this method the organic substances were removed from the water by adsorption on activated carbon and subsequent elution. Oxygenated substances which interfere with the hydrocarbon identification were removed by adsorption of silica gel. The aliphatic and aromatic hydrocarbons separated by chemical and chromatographic procedures were identified by the resemblance of their i.r. spectra to the spectral patterns of refinery waste hydrocarbons.

This method provides chemical evidence, independent of odour evaluations, of the presence of low concn of petroleum refinery wastes in surface waters. J. S.

1594. Spectrophotometric determination of aliphatic sulphides in crude petroleum oils and their chromatographic fractions. H. V. Drushel and J. F. Miller. *Analyt. Chem.*, 1955, **27**, 495–501.—A method is described for the determination of aliphatic sulphides in small samples of crude petroleum or crude petroleum chromatographic fractions. The method is based on a modification of the Hastings procedure by using higher iodine concn, thus giving increased sensitivity. The use of a Beckman DU spectrophotometer with photomultiplier attachment made it possible to use smaller samples, which in turn decreased sample background absorption, thus making it possible to analyse samples containing higher concn of aromatic hydrocarbons. Interference due to formation of hydrocarbon–iodine complexes was found to be negligible. The method should prove useful for following the course of isolation or concn of aliphatic sulphides from crude petroleum by techniques such as chromatography and thermal diffusion, and should be helpful in characterizing crude petroleum prior to refinery operations. J. S.

1595. Colorimetric determination of *n*-phenyl-1-naphthylamine in new and used oils. S. W. Levine and W. A. Marshall. *Analyt. Chem.*, 1955, **27**, 1019–22.—A rapid colorimetric method has been developed for determining *n*-phenyl-1-naphthylamine in new and used oils. The oil is dissolved in acetone and diazotized *p*-nitroaniline is added, which produces a blue coloration, the intensity of which was compared with a calibration curve. The method is rapid, requiring only 18–20 minutes for a sample determination. The accuracy is within $\pm 10\%$, which is considered satisfactory for blending plant control work and routine analysis. High results may be obtained with very badly oxidized oils. J. S.

1596. Determination of aromatic content of petroleum products. C. Costantinides, C. Arich, and S. Rotteri. *Riv. Combust.*, 1956, **10** (7–8), 515–30.—The authors propose the adoption of a method for controlling the aromatic content of petroleum products which differs from the nitration test currently employed by Customs officers. The suitability and reliability of this method have been corroborated by an extensive series of selective absorption tests on silica gel, followed by an examination of some characteristic i.r. absorption bands. (Authors' summary.)

1597. Rapid polarographic determination of tetraethyl lead in gasoline. W. Hubis and R. O. Clark. *Analyt. Chem.*, 1955, **27**, 1009–10.—The cellosolve–hydrogen chloride procedure for the decomposition of TEL and subsequent extraction of lead from gasoline is subject to error with certain samples when the lead is determined polarographically. This error was essentially eliminated by simple modifications to the original procedure: (1) to cooling the cellosolve in an ice bath during acidification with anhydrous hydrogen chloride; (2) the addition of a small amount of gelatin; and (3) addition of water to the cellosolve–hydrogen chloride following decomposition of the TEL. J. S.

1598. Determination of TEL in gasoline by X-ray fluorescence. F. W. Lamb, L. M. Niebylski, and E. W. Kiefer. *Analyt. Chem.*, 1955, **27**, 129–32.—The X-ray fluorescent method for the determination of TEL in gasoline was investigated to determine its possible advantages in speed and accuracy. The method was found to be rapid, 5–10 minutes/sample, and had an average error of $\pm 0{\cdot}026$ ml of TEL/gal. The error due to sulphur was found to be small, and additives such as phosphorus in concn 10 times those normally found in gasoline were shown to have no measurable effect. A study of the matrix effect showed that the same analytical curve could be used to determine TEL in gasoline whether present alone or as motor mix or as aviation mix anti-knock cpd. The effect of carbon–hydrogen ratios is directly related to density, indicating the need for a correction factor based on density. J. S.

1599. Reduced-scale Reid vapour pressure apparatus. R. L. Le Tourneau, J. F. Johnson, and W. H. Ellis. *Analyt. Chem.*, 1955, **27**, 142–4.—An apparatus to measure Reid v.p. of small samples consists of a sample cup to fix the liq–vapour ratio and a pressure transducer to convert the pressure into an electrical equivalent which is measured by an aux detecting circuit. The range is 0–20 lb. A sample of only 3 ml is required. The time required to handle a sample properly and make a measurement is *ca* ¼ less by this method than by standard methods, and less bench space is required. The precision is as good as that of standard methods. J. S.

1600. Gas–liquid chromatography—separation of hydrocarbons using various stationary phases. V. T. Brooks and G. A. Collins. *Chem. & Ind.*, 1956, 921.—By choice of suitable stationary phase separation of hydrocarbons can be effected either by b.p. or mol type. Use of polyethylene glycol enables almost complete separation to be made between aliphatics and aromatics boiling up to 200° C. A non-polar phase, *e.g.* liq paraffin, gives better separation of homologues. A table is given of retention vols (relative to C_6H_6) of 9 aliphatic, 4 alicyclic, and 16 aromatic hydrocarbons on each of 6 stationary phases. W. A. M.

1601. Effect of pressure, temperature, and well stream composition on the quantity of stabilized separator fluid. W. E. Portman and J. M. Campbell. *J. Petrol. Tech.*, 1956, **8** (5), 59–62.—Correlation charts have been prepared for field use in predicting the amount of stock-tank fluid produced by stabilization of first stage separator fluid. These charts are not recommended for use below 200 p.s.i.a. or above 1250 p.s.i.a., or where the separator liq is less than 40° API. A check against 30 computed results showed an average error of less than -3%. The authors' experience with many separator installations has shown that computed recoveries are on average *ca* 7% in error when compared with actual recoveries, and consequently the error when using the charts should not exceed 10%. G. D. H.

1602. Digital computers speed gas analysis. H. A. Young. *Oil Gas J.*, 6.8.56, **54** (66), 78.—Normally an hour or more is required for calculating by desk calculator the results of a mass spectrometer gas analysis. By the use of a digital computer this can be shortened to 10 minutes. G. A. C.

GAS

1603. Possible uses of combustible natural gases. V. Charrin. *Chim. et Industr.*, 1956, **75**, 602–4.—St Marcet gas reserves are 4×10^9 m³, equivalent to *ca* 12 years supply at present offtake. Lacq reserves are 15×10^9 m³ min, industrial exploitation is planned to commence in 1957 with a recovery of 70,000 tons/year S. Correction is made of figure previously (*cf* Abs. **338**, 1956) given for French carbon-black requirements, which are 35,000–40,000 tons/year and not 7000. V. B.

1604. Natural gas. J. Burns and L. J. Clark. *Riv. Combust.*, 1956, **10** (7–8), 491–514.—Natural gas is one of the main sources of power, but is not easy to transport, like coal or petroleum. It may be found alone or associated with petroleum, in the latter case the gas is separated from the petroleum at the well, and in many areas, where there is no local demand or no means of transport elsewhere, is burned and hence wasted. The suggestion has therefore been put forward of liquefying this gas at atm pressure and temp in the neighbourhood of −165° C, so that it can be transported in special insulated tankers to countries where it can be usefully employed. On arrival it would be discharged in liq form to ground tanks, suitably insulated and subsequently regasified for supply to the public and industries, both in the existing condition (at 8800 k.Cal/m³) and converted into a gas interchangeable with town gas. Most of the technical angles of the processes involved in pre-treatment liquefying, storing, and conversion of natural gas are described. The equipment with which for the moment experience is lacking is the ocean tanker with insulated tanks able to transport extremely low-

temp liq. Some of the design problems arising with these tankers are discussed, and it is believed that they can be solved. A broad picture is drawn of the economic set-up for intercontinental transport of liq natural gas, the conclusion being reached that the project is a promising one provided that the gas costs relatively little at origin.
(Authors' summary.)

1605. Remote gas production by simultaneous gasification of coke and oil. W. Ohme. *Erdöl u. Kohle*, 1956, **9**, 17–18.—Operational conditions are determined for successful working in an experimental water gas generator. Cal. val. of gas produced by varying oil quantity or switching times of generator lies between 2700 and 5000 k.Cal/Nm³. Remote gas of 4600 k.Cal/Ncm³ is obtained easily. Sp oil and steam requirements are tabulated. R. T.

1606. Possible development in the use of liquid methane. Anon. *Petrol. Times*, 3.8.56, **60** (1539), 668.—This is an abstract of a paper presented by J. Burns to the 93rd Annual General Meeting of the Institute of Gas Engineers in London, 1956.

Source and quality of gas for liquefaction, transportation, economic considerations, and possible liq gas installations in Britain are dealt with; and it is concluded that the value of natural gas in extending the gas industry's range of raw materials and giving production flexibility is real and may be of increasing importance. G. A. C.

1607. Valuation and estimation of liquefied gas according to the present position of the standardization. T. Hammerich, H. Möller, and E. Sasse. *Erdöl u. Kohle*, 1956, **9**, 98–102.—Quality conditions and tests for liq gases (C_3 and C_4)—arranged by distributor and user—are intended to deepen the necessary knowledge by a series of experiments undertaken by a panel. R. T.

1608. Oil and gas in the St Lawrence lowland of Quebec. T. H. Clark. *Canad. Min. metall. Bull.*, 1956, **49** (531), 480–4.—A 5 million cu. ft/day discovery of natural gas at 200 ft, which lasted for 76 days before the well was plugged, indicates the possibility of commercial production in the Pointe du Lac area, and has provided an additional incentive to study the lowland in detail (an outline only is given in the paper). Notes are, however, given on the actual oil and gas occurrences in the lowland. 3 figs. M. P. T.

ENGINE FUELS

1609. Canadian octanes approach United States levels. J. A. Nevison and H. R. Crane. *Oil Gas J.*, 20.8.56, **54** (68), 234.—The average Canadian premium gasoline is only 2 O.N. below the average U.S. premium, and from now on is expected to be one or less. Production methods are discussed, and tables show characteristics of components. G. A. C.

1610. Are diesel fuels better than necessary? G. L. Farrar. *Oil Gas J.*, 13.8.56, **54** (67), 113.—The author states that cetane No. of diesel fuels marketed in the U.S.A. is substantially higher than necessary, dist end point is lower than required for good operation, and other specifications, such as gravity, visc, pour point, carbon residue, and corrosion, are higher than necessary. G. A. C.

1611. Using sump oil as a fuel. F. Evans. *Oil*, 1956, **3** (6), 13–15.—The article deals with the wartime development of a burner to dispose of sewage wastes. The most freely available fuel was waste sump oil, and 3 parts of oil mixed with one part water proved quite efficient. C. B.

GAS OIL AND FUEL OIL

1612. The formation of sulphur trioxides in flue gases. P. H. Crumley and A. W. Fletcher. *J. Inst. Fuel*, Aug 1956, **29** (187), 322.—Investigations have been made in a small kerosine-fired furnace to determine the factors controlling the formation of SO_3 in the combustion of fuels containing sulphur. SO_3 contents of the flue gases were determined chemically and were shown to depend on the sulphur content of the kerosine, flame temp, amount of excess air, and type of flame. SO_3 contents of flue gases from a large oil-fired boiler have been determined and compared with results obtained in the small furnace. D. K.

1613. Some experiences in vessels equipped with two-stroke cycle Harland and Wolff opposed piston diesel engines using boiler oil. A. G. Arnold. *Trans. Inst. Mar. Engrs*, 1956, **68** (7), 201.—The author gives details of experiences with 9 vessels propelled by 2-stroke cycle Harland and Wolff opposed piston diesel engines. The maiden voyage of *Demodocus* is described. The article is well illustrated, and the discussion and author's reply are appended. D. K.

LUBRICANTS

1614. Bearings, lubricants, and lubrication. Anon. *Mech. Engng, N.Y.*, 1956, **78** (8), 703.—A digest of 1956 literature considered from the following aspects: journal bearings, thrust bearings, hydrostatic bearings, boundary lubrication, metalworking lubrication, roller-element bearings, gears, automotive lubricants, properties of lubricants. There are 208 literature refs. D. K.

1615. Conditioning plant for steam turbine oils. Anon. *Mech. World*, Aug 1956, **136** (3445), 354.—2 types of oil-conditioning plant are available, the wet and dry types. In the dry type plant, dehydration is carried out by mechanical means using a precipitator and 2 dehydration chambers. The wet type uses vacuum dehydration with the aid of a precipitator and heater. Both systems of conditioning include a de-aerator-separator for dealing with air and free water, a heat exchanger for coagulating treatment, and the pressure filter for removing dispersed matter. The choice between the 2 types depends largely upon the amount of water present and careful analysis of impurities found in the oil. A diagram of a typical conditioning plant is presented. D. K.

1616. Possibilities of lessening friction on the frictioned surfaces through the best choice and use of lubricant coating. D. Krpan. *Nafta (Yugoslavia)*, 1956, **7** (8), 237–45.—Working characteristics of Yugoslav lub oils have been examined and compared in order to facilitate the choice of the best lub oil for the prescribed working conditions. The examinations have established the necessary amounts of power to overcome the resistance of the friction in the bearing, the coeff of the friction, and the temp of the bearing. The relation of the obtained characteristics indicates the best working range for each type of oil. (Author's abstract.)

1617. Oil test laboratory. Anon. *Auto. Engr*, 1956, **46** (8), 301.—A description is given of the new lab established at the Inspectorate of Fighting Vehicles, Ministry of Supply. This lab is concerned only with mechanical testing of engine oils and gear oils. The primary function is to test oils against agreed standards, and a secondary function is to carry out special investigations at the request of M.O.S. Engine Oil Advisory Panel or Chemical Inspectorate with the object of improving repeatability and reproducibility of test procedure and with a view to developing improved test techniques. D. K.

1618. Effect of combustion resistant hydraulic fluids on ball bearing fatigue life. H. V. Cordiano, E. P. Cochran, Jr., and R. J. Wolfe. *Trans. Amer. Soc. mech. Engrs*, July 1956, **78** (5), 989–96.—The effect of phosphate-based fluids and petroleum oils on angular contact ball bearing fatigue life was investigated in test machines. It is concluded that bearing life was shorter in the combustion-resistant fluids than in the oil. All fluids gave rise to bearing race failure, and it was decided to investigate further the wide variations in bearing life in the various fluids. Several figures and 7 refs are given. C. B.

1619. Behaviour of air in the hydrostatic lubrication of loaded spherical bearings. T. L. Corey, C. M. Tyler, Jr., H. H. Rowand, Jr., and E. M. Kipp. *Trans. Amer. Soc. mech. Engrs*, July 1956, **78** (5), 893–8.—The use of air as the hydrostatic lub medium is investigated, and equations for the calculation of (1) minimum air pressure as a function of load; (2) minimum flow of air as a function of pressure; (3) bearing lift as a function of air pressure are developed. Load-carrying capacity was also studied under varying conditions of temp, film thickness, pressure, and flow rates. Loaded steel balls of 2-, 4-, and 6-inch dia were used throughout the investigation. One ref. C. B.

1620. Density–pressure–temperature relations for liquid lubricants. H. A. Hartung. *Trans. Amer. Soc. mech. Engrs*, July 1956, **78** (5), 941–7.—Correlations are drawn between various published data on the separate effects of pressure and temp on the density, and a method for predicting density at temp up to 425° F and 80,000 p.s.i. from the density at room temp, and atm pressure and the visc at 100° F is demonstrated. The oils used were of all types, and while correlations applied to pure hydrocarbons, petroleum fractions, polymer-blended lubricants, and commercial oils, certain synthetics showed irregularities. Several figures and 5 refs are given. C. B.

1621. Prediction of lubricating oil viscosities at high pressures. O. H. Clark. *Trans. Amer. Soc. mech. Engrs*, July 1956, **78** (5), 905–8.—The feasibility of the assumption that the effect of pressure on visc is established when the effect of temp is known, is tested using data from the ASME project on high pressure visc. 2 scales, for paraffinic and naphthenic oils, were required to enable graphs to be drawn. The accuracy of the predictions of high pressure visc using this method is discussed. 7 refs. C. B.

1622. Emulsion-type lubricants and liner wear. Anon. *Mot. Ship*, July 1956, **37** (434), 111.—An economic consideration is presented of the use of emulsion-type lubricants in marine diesel engines. Compared with conventional oils, emulsion-type lubricants (costing about 2*s*/gal more) reduce liner wear up to 70%, but increase oil consumption by approx 30%. An analysis of saving *v.* additional cost suggests that emulsion lubricants are more economical. D. K.

SPECIAL HYDROCARBON PRODUCTS

1623. Performance of transformer oil under special conditions. W. E. Elliott, F. J. Vogel, and D. N. Hiu. *Trans. Amer. I.E.E.* (*Power App. & Syst.*), 1956, (23), 108–12.—Uninhibited and inhibited (0·3% DBPC) oils tested alone and in presence of Cu + Fe + paper (varnished (phenolic-alkyd) and unvarnished) for one year in N_2 atm at 105° C. Detailed chem, phys, and elect tests done on aged oils, on same oils kept at room temp, and on oils aged under same conditions but with fortnightly flushing of gas space with N_2. Results indicate that N_2 flushing causes increased deterioration, possibly due to 0·1% O_2 present in N_2. Under sealed conditions inhibited oil shows little or no advantage over straight oil. In presence of varnished (as compared with unvarnished) paper considerably more deterioration occurs in both straight and inhibited oils, and the latter give slightly worse results. V. B.

1624. Field survey of transformer oil quality. W. J. Degnan and E. J. Shimanski. *Amer. Inst. Elect. Eng.*, 1956, Preprint CP/805. 11 pp.—Oils drawn from 71 large transformers (<100,000 kVA, <115 kV) spread throughout the U.S.A.; units were conservator-fitted, gas sealed, or gas-oil sealed, in one case sealed; service period was 1–17 years (no reclamation, 6 units filtered). Following characteristics were determined on oil [illegible]nge), italicized value represents worst deterioration f[illegible]% of the units: water, p.p.m. (7–22) *15*; dielectric strength, VDE (37–60) *44*; dielectric strength, ASTM (24–45) *31*; p.f./25°C% (0·02–0·4) *0·2*,/100° C (0·6–8); resistivity/25° C, 10^{12} ohma-cm (6–98) *9*,/100° C (0·1–13); acidity, mg KOH/g (0·006–0·051) *0·045*; colour, ASTM ($\frac{1}{2}$–2$\frac{1}{2}$) *2*; visc (54–57 sec); IFT, dynes/cm (21–42) *24*. All oils are fit for further use. No noticeable effect on properties due to geographic location or type of transformer cooling, age of oil has some effect on: p.f., resistivity, IFT, colour, acidity. Apart from acidity, where very slightly higher values are given by conservator units, type of oil-preservation equipment does not affect age-dependent factors. V. B.

1625. Effect of hydrostatic pressure and applied voltage duration on the breakdown strength of insulating oil. P. K. Watson. *Amer. Inst. Elect. Eng.*, 1956, Winter meeting, Conf. paper No. 424, 9 pp.—With 50 c.p.s., $\frac{1}{4}$-inch spheres, 3–4 mm gap, breakdown voltage at atm pressure was 140 kV rms/cm, this increased to 400 kV/cm after filtration; filtered oil had distinct min in pressure/breakdown voltage curve at 40 mm (300 kV/cm). Using rectangular millisec pulses at atm pressure values of 710 kV/cm were obtained, rising to 1100 kV/cm for degassed oil; if air was allowed to re-dissolve in oil value reverted to 700 kV/cm. Tests at increased pressure showed marked pressure dependence of breakdown strength up to 75 p.s.i. Using microsec pulses (0·005–0·02 mm gap), a different (ionic) breakdown mechanism appears to operate. Hence at long duration of applied voltage particle migration into high stress regions occurs, causing breakdown; at millisec voltage duration higher fields are required, and cause a cavitation breakdown, both these forms of breakdown are pressure-dependent. At microsec durations intense fields are required, to cause breakdown by an ionic mechanism. V. B.

1626. Petroleum fuels for domestic heating and lighting. D. G. Tompkins and G. F. J. Murray. *J. Inst. Petrol.*, May 1956, **42** (389), 129–47.—The article reviews the markets for, and the applications of, various petroleum products. After a brief mention of paraffin wax and LPG the authors consider light fuels. A cat stove used in France is mentioned. Kerosine burning appliances, including lamps, space heaters, irons, refrigerators, and cooking appliances, are then described. Pt II covers the uses of fuel and gas oils, and various burner systems are illustrated and described. Both water- and space-heating are considered, and fuel characteristics conducive to efficient operation stressed. The paper is well illustrated, and 7 pages of discussion are included. C. B.

1627. Determination of flash point of solvent type waxes. D. E. Whyte, W. K. Miller, R. H. Simon, A. K. Light, and C. A. Gerardi. *Soap, N.Y.*, 1956, **32** (8), 133.—Different methods of fl. pt. determination are discussed, together with factors to be controlled when determining the fl. pt. Efficient stirring and a slow heating rate are essential to the control of local heating. A method has been developed which differs from ASTM D93 in only 3 points; the test is started between 70° and 80° F instead of 30° F below the expected fl. pt., the heating rate is maintained at 1·8° ± 0·2° F instead of 9°–11° F, and the mixture is stirred in a clockwise direction at 300 rev/min. The author concludes that the fl. pt. of a wax product should not differ appreciably from that of its solvent. 14 refs. D. K.

DERIVED CHEMICAL PRODUCTS

1628. Petrochemicals are on the march in Canada. J. C. Reidel. *Oil Gas J.*, 20.8.56, **54** (68), 217.—A review of the industry in Canada shows plant expansion for production of polyethylene, ammonia, sulphur, and hydrocarbons. A survey of the petrochemical plants in Canada is given. G. A. C.

1629. Synthetic detergents from petroleum derivatives. M. Maretic. *Nafta* (*Yugoslavia*), 1956, **7** (7), 206–11.—The principal types of synthetic detergents are given. Different petroleum derivatives can be used for synthetic detergent production, and their choice depends to a great extent upon the state of development of the petroleum industry. It

seems that the secondary alkyl sulphates are the simplest and most suitable from the point of view of a not-too-developed petroleum industry, since for their production olefins of kerosine are sufficient. The production of olefins does not require complex processes of petroleum manufacturing.
(Author's abstract.)

1630. *p*-Xylene from petroleum. H. W. Haines, J. M. Powers, and R. B. Bennett. *Chim. et Industr.*, 1956, **75**, 75–84.—*Cf.* Abs. **354**, 1956.

1631. Raw materials for petrochemical industry. P. Gustavson. *Nafta* (*Yugoslavia*), 1956, **7** (7), 211–15.—The possibility of providing gaseous olefins for Yugoslav chemical industry is discussed. Sufficient quantities of propylene and butylene will be available from cat cracking plants. The production of ethylene for this purpose in a separate plant would not be profitable, as the requirements of the chemical industry are too small. (Author's abstract.)

COAL, SHALE, AND PEAT

1632. The combustion of solid fuels and the aims of flame radiation research in relation to the burning of pulverized coal. D. T. A. Townend. *Ingenieur, 's Grav.*, 2.4.56, **68** (14), W41–8.—After classification of the different ways of burning coal in fixed beds or in suspension, the main characteristics of these systems are dealt with. It is shown that for the burning characteristics of coal in suspension studies on the mechanism and the rate of combustion of single particles, and especially of the ignition of the volatiles, are important. Large-scale research work on pulverized coal combustion has been rather scarce, and the work to be done in Ijmuiden will be of great value. After briefly mentioning the work and results on gas and oil firing, reference is made to the programme of work to be undertaken in the coming years. The great value of international co-operation on such a research project is particularly stressed. (Author's abstract.)

1633. A contribution to the knowledge of Yugoslav oil shales. F. Sef. *Nafta* (*Yugoslavia*), 1956, **7** (8), 233–6.—The results of the exploration of the oil shale reserves at Sinj and Aleksinac are given. The chemical composition of typical samples are also given. The oil shales of Sinj, both the main layer and the roof of the intercalation bituminous layer, are deposited in marl and marly limestone along the Ruda rivulet in the direction ENE.–WSW. The Mala Ruda rivulet divides the area into 2 parts : terrain A of 1500 m length and 500 m average width, and terrain B of 2580 m length and 350 m average width. Only the reserves of the south half of terrain A are exactly explored and estimated at *ca* 3·5 million tons. *Ca* 65% of these reserves could be commercially exploited. The strata of these reserves reach a depth of 470 m, the main stratum of 2·4 m average thickness in a dip-angle of 49° and the roof with the intercalation bituminous layer of 4·9 m average thickness in a dip-angle of 49° 50′. The oil yield of the main stratum is 18·5%, that of the intercalation bituminous layer in the roof 15·6%, and the average oil yield of the entire structure of the S. part of the terrain is 16·5%. Considering the extension of both terrains A and B, the total reserve of oil shales of Sinj is estimated to be almost 4 times greater that the explored structure. Nevertheless, further exploration has been stopped. It has been proved that, in spite of the convenient chemical composition, the mining of these oil shales under existing conditions would not be profitable. The oil shales of Aleksinac are deposited in clay-shales which form the roof of the coal layer now exploited. They are further deposited in the upper part of sand and clay strata which build the floor of this coal layer. The thickness of the deposits and the grades of oil yield vary according to their direction and dip. The best explored, those in the roof of the coal layer, are deposited in 2 strata. The thickness of the first stratum varies from 12 to 15 m, that of the second from 20 to 26 m. The average oil yield is 9–14% in the first and 13·3–14·8% in the second stratum. The oil shale deposits beneath the coal layer are considerably less explored. Their thickness on the intercrossing is 30 m, the average oil yield 11·2%. The reserves of oil shales in the area of the existing coal-mine shafts are estimated at 750 million tons. Only *ca* 311 million tons could be exploited, due to the necessity of protecting inhabited or built-up areas. The average oil yield of these deposits is 12%. The analysis of samples from both places has found 13·3–44·3% organic matter, 6·7–27·0% oil (tested according to Fischer), and 0·56–0·78% total nitrogen. There is a considerable difference between the 2 kinds of oil shales regarding the content of total sulphur. The oil shales of Sinj with 31·6% organic matter have 1·53%, and those of Aleksinac with 30·6% organic matter have 3·28% sulphur. The chemical composition of ashes indicates that the inorganic part of the Sinj oil shales to a great extent consists of calcite and smaller quantities of clay minerals, whereas the inorganic part of the Aleksinac oil shales chiefly consists of clay minerals, calcite, or dolomite. (Author's abstract.)

CORROSION

1634. Corrosion problems on the Texas Gulf Coast. A. D. Rust. *Corrosion Tech.*, 1956, **3** (5), 134–7; **3** (6), 185–90.—This article (in 2 parts) is concerned primarily with corrosion and associated subjects as encountered at the 2 plants of The Dow Chemical Co, Freeport, Texas. These plants are situated *ca* 6 miles apart on the coastal plain of the Gulf of Mexico, where climatic and other conditions are such that proper control of corrosion is imperative to successful operation. Whereas Pt 1 is concerned primarily with atm corrosion and painting, Pt 2 is concerned with sea-water corrosion.

The appearance of the plants is said to be maintained at a higher level than the average chemical plant, and this pays satisfactory returns. 11 figs, 2 tables. M. P. T.

1635. Stanolind fights corrosion in three sulphur recovery plants. J. W. Kilner, M. H. Rahmes, and H. L. Lawler. *Oil Gas J.*, 9.7.56, **54** (63), 84.—Principal cause of corrosion in 3 sulphur-recovery plants of the Stanolind Oil-Gas Co is solution of corrosive gases in moisture condensed from the process stream. Conditions in the 3 plants are stated and solution of the problem given as redesign of equipment to minimize contact of the process stream and cool metal surfaces or external insulation of metal surfaces to prevent moisture condensation. G. A. C.

1636. Ashes in domestic oils. D. Tarjan and I. Lovrecek. *Nafta* (*Yugoslavia*), 1956, **7** (6), 172–83.—The authors discuss the origin and composition of ashes in oils, examining further the destructive effects of these mineral substances on the walls of fire boxes and the causes of corrosion of the steel parts of ovens and gas turbines. Vanadium is the most destructive. These mineral substances spoil cat used in cracking. The methods of determining the content and composition of ash are described. The composition of ashes in fuel oils, dist, and residues have been determined. The composition of water deposited from oil, dross, and brick from various parts of the oven have been examined. The authors have found nickel and vanadium in fuel oil ash in quantities which could be used in industry. In this direction tests have been made.
(Authors' abstract.)

ENGINES AND AUTOMOTIVE EQUIPMENT

1637. New Smit-Bolnes diesel engine. Anon. *Mot. Ship*, July 1956, **37** (434), 135.—An enlarged version of the Bolnes engine is now being built at L. Smit & Zoon, Holland. It has a power range of 500–1250 b.h.p. at 275 rev/min and is arranged for direct reversing. The engine is a 2-stroke non-pressure-charged type, and uses longitudinal scavenging by crosshead pistons. Welding is employed throughout, which reduces the weight. The cyl head is of cast-steel. A diagram is included. D. K.

1638. A Sulzer turbocharged engine on test. Anon. *Mot. Ship*, Aug 1956, **37** (435), 154.—Test performance data are given for the 9RSAD76 engine. It is a 9-cyl crosshead-type unit with a bore of 760 mm, a piston stroke of 1550 mm, and a rated output of 11,700 b.h.p. (b.m.e.p. 7·05 kg/cm^2 or 100 p.s.i.) at 119 rev/min, the max output being 13,500 b.h.p. It has a fuel consumption of 152 g (0·334 lb)/b.h.p. hr. The article is very well illustrated. D. K.

1639. A new Brush turbocharger. Anon. *Mot. Ship*, Aug 1956, **37** (435), 167.—A new design of exhaust-gas-driven turbocharger for diesel engines introduced by the Brush Electrical Engineering Co Ltd is described. It will probably be restricted to engines up to 2500 b.h.p. D. K.

1640. Nuclear gas turbines. Various. *Mech. Engng, N.Y.*, 1956, **78** (7), 606.—Symposium covering the applications of various gas turbine power systems to nuclear reactors based on 4 papers read to a meeting of ASME, Washington, 8 Dec 1955. D. K.

1641. Firebird II. Anon. *Auto. Engr*, 1956, **46** (6), 234.—Notes on the second experimental gas turbine car by General Motors Corpn, GT 304. Brief descriptions are given of the regenerative heat exchanger, body features, suspension, braking system, transmission, centralized hydraulic system, electrical system, accessory equipment. D. K.

1642. A free piston gas turbine for cars—some technical features of a General Motors–S.E.M.E. twin unit. Anon. *Oil Eng.*, July 1956, **24** (275), 109–10.—A brief description of the car is given. The power unit and its operation are described, and the advantages of the free-piston turbine discussed. The article is a discussion of a paper entitled "The GMR4-4 Hyprex Engine," by A. F. Underwood, presented to the Society of Automotive Engineers in June 1956. C. B.

1643. The future of gas turbines. Anon. *Mot. Ship*, July 1956, **37** (434), 124.—A synopsis of the paper read by A. A. Hafer recently to the Southern California Section of the Society of Naval Architects and Marine Engineers. The 6000-b.h.p. gas turbine for the merchant vessel *John Sergeant* is described and its estimated cost of maintenance discussed. It is proposed to operate the turbine on residual fuel oil which has been treated to reduce harmful effects of V and Na. The question of the use of turbines in nuclear propulsion plant for marine propulsion is also discussed. D. K.

SAFETY PRECAUTIONS

1644. Recommendations in connexion with liquid fuel. Anon. *Instn Fire Engrs Quart.*, 1955, **16** (22), 134–8.—These revised recommendations, issued by the Fire Offices' Committee, refer to liq fuel (including coal tar fuels) having a fl. pt. not below 150° F (closed test). The recommendations are prefaced by a note pointing out that arrangements should conform to B.S. 799—"Oil Burning Equipment."
(Editor's abstract.)

MISCELLANEOUS

1645. Energy resources—how thin? R. G. Dressler and R. R. Cruse. *Chem. Engng*, 1956, **63** (7), 173–6.—The estimated 25% jump in the population of the U.S.A. by 2000 will lead to much larger energy requirements. U.S. coal reserves are estimated at 1·9–2·5 trillion tons, which should last 1700–4000 years. 1955 proven U.S. petroleum resources are 36·9 billion brl. Production was 2·47 billion brl, or 35·7% of total fossil energy consumed. At present the discovery of new reserves keeps pace with production, but this situation will not last more than *ca* 10 years. U.S. shale oil reserves are 500 billion brl. So far reserves of natural gas have held constant at 214 trillion cu. ft., but the yearly demand is increasing. The production of uranium ore in the U.S.A. has doubled every 18 months since 1950, and lately lithium has been considered as a nuclear fuel source. By 2000 U.S. nuclear energy potential will be a max of 15×10^{15} B.t.u. annually, which is 15 times present-day coal consumption. Solar energy, wind power, and hydroelectricity will be used to supplement these main energy sources. D. H. A.

1646. Future of the petroleum industry in the U.K. C. P. Dalton. *Inst. Petrol. Rev.*, Aug 1956, **10** (116), 213–16.—The petroleum market is rapidly widening, and by 1965 will probably have doubled in size. The demand for fuel oils is expected to be greater than that for all other products combined. Subsequently with the growth of atomic power, the rate of expansion may decrease, and coal, oil, and the atom exist together. The estimated capital requirement for this development is £1000 million, most of which must come from the industry's earnings. S. L. C.

1647. World market trends and role of Middle East oil. C. T. Barber. *Oil Forum*, 1956, **10**, 19–20.—From 1913 to 1955 world energy consumption increased from 6 to 35%. Over 50 years world oil demand has increased by 6·6% p.a. At the end of world war I the U.S.A. produced 71%, Middle East 2% of 69 million tons total. In 1938 the U.S.A. produced 61%, Middle East 6% of 272 million tons world production. In 1944 known reserves totalled 1500 million tons, America 34%, Middle East 42%. World reserves are estimated at 20,000 million tons, Middle East 8000 = 65%, the U.S.A. 20%. R. T.

1648. Strategic importance of Middle East oil. E. M. Eller. *J. Petrol. Tech.*, 1956, **8** (5), 15–19.—It is contended that the U.S.A. has not attached sufficient importance to the Middle East as a whole. Yet its oil resources are of profound importance to the West, not only in peace but even more so if war comes. Russian policy is aimed at acquiring these resources. The U.S.A. and the allies would be crippled, if not brought to disaster, by the loss of Middle East oil and of the control of the seas which makes it possible to use that oil. G. D. H.

1649. Japan's petroleum industry. H. R. Connell. *Oil Forum*, 1956, **10**, 21–2, 59–60.—Pt I. Reserves—Pliocene and Miocene character—were estimated at 20,678,675 brl in June 1954. Mining law restricts operation to nationals. Operative wells dwindled from 6000 in 1940 to 3194 in 1949. Improvement due to Government aid is reported. Fuel oils marketed by large companies; lub oils imported by 42 firms. Major marketers (12) account for *ca* 99% of total market for petroleum products. A gasoline "use" tax, *ca* 13·7 c/U.S. gal is in effect. Aim is 6,289,900 brl p.a. production by end of 1957. Pt II. Departing from concept of balancing refining capacity with domestic crude production, Japanese

refineries began to process foreign crude by 1924. Now 18 refineries have total throughput capacity of 225,000 b.d. Large quantities of petroleum products produced, *e.g.* lub oils by solvent refining. Fully refined 130/134 paraffin by dewaxing lub oils renders U.S. imports uncompetitive. Production of 300,000 tons p.a. of petrochemical products is planned. 5 refining companies have 50% foreign financial participation. Future of imports may lie in items for processing. R. T.

1650. How Guatemala's taxes affect oil operators. Land owners share royalties. R. T. Brinsmade. *Oil Forum*, 1956, **10**, 218–19.—All holders of petroleum rights in Guatemala must pay income tax on all transactions. Net profit and legal deductions are defined. R. T.

1651. The Petrofina story. Belgian oil group has plenty of bounce. Anon. *Oil Forum*, 1956, **10**, 135–40.—Petrofina, from almost complete destruction by the end of world war II, has established a growing, completely integrated, global group of subsidiary concerns with current net production 20,000 b.d., 85,000 b.d. current total refinery capacity, and an extensive distributing and marketing system. A financial tabulation is given. R. T.

1652. Liberated Austrian oil flexes its muscles. L. Walter. *Oil Forum*, 1956, **10**, 94–5.—German and Russian activities are discussed. Oil reserves in Vienna basin 80 million tons. Processing capacity of 5 refineries is 1,800,000 tons p.a. R. T.

1653. Some changes in Venezuela's oil laws. R. T. Brinsmade. *Oil Forum*, 1956, **10**, 86–7.—Effects of changes in Venezuela's oil laws governing new petroleum concessions—in abeyance since 1945—are presented. R. T.

1654. Venezuela reaffirms 50–50 split for future concession grants. C. Perez de la Cova. *Oil Forum*, 1956, **10**, 124–6.—Venezuela's President considers granting new oil concessions to strengthen and expand domestic oil industry. Essential requirements for concessions are given. R. T.

1655. Petroleum's ten year expansion bill twice U.S. national budget. Anon. *Oil Forum*, 1956, **10**, 84–5.—In the next 10 years expenditure to maintain and expand world petroleum industry will be *ca* $115,000,000,000. Growth laws affect oil demand. Consumption follows a compound-interest curve. Present annual expenditures of *ca* $8000 million will increase progressively to *ca* $12,000 million. R. T.

1656. Considerations concerning bank financing of oil and gas properties. J. E. Warren. *J. Petrol. Tech.*, 1956, **8** (5), 11–14.—The search for and development of oil properties is principally directed towards creating new wealth, whereas the main function of banking is to perform business services which involves conservatism and small risk. Oil loans differ widely, and in making them the banks must depend in part on engineering reports on the properties. All appraisal methods applicable in a given case should be used as a check on the conclusions; data should be checked where possible, and their limitations noted. Reserves and their productivity must be translated into cash terms, and this involves estimates of future trends, values, and technical developments. There are also legal, political, and tax considerations. The first 2 can markedly affect the security value of properties, while tax provisions now add to the cash flow available for loan servicing, but changes could easily cause a deterioration of this situation.

Petroleum is a vital commodity and is expected to remain so, but economic cycles do exist, and competition from new sources of energy may develop. G. D. H.

1657. The Fifth World Power Conference. Anon. *Petrol. Times*, 17.8.56, **60** (1540), 721.—Reviews are given of the 10 papers read at the Vienna Conference 1956, and subjects include energy resources of the U.K., oil for future generation in homes, oil and future energy supplies, the Middle East and the oil supply pattern, recent trends in oil-refining techniques, a gas reforming plant for cracked oil gas, oil and town gas in the U.K., petroleum and the French gas industry, the development of natural gas in France, and natural gas transmission in Italy. G. A. C.

1658. Current news. Anon. *Nafta* (*Krakow*), 1955, **11**, 50.—The Ministry of Mining split up the existing 4 regional exploitation units into 7.

Petroleum publications were the subject of a conference between Ministry of Mining, Academy of Mining and Foundry, Institute of Petroleum, Association of Engineers, and other interested parties. M. S.

1659. A legal department in an oil company. F. U. J. O'Brien. *J. Inst. Petrol.*, June 1956, **42** (390), 159–67.—The author describes the functions of the lawyer in the oil business. The activities of the legal department of the Sholl Petroleum Co are surveyed, and the wide scope of the work in the fields of refining, marketing, storage, and transport is stressed. 5 pages of discussion are given. C. B.

1660. That octane improvement headache. R. C. Kersten and T. W. Warren. *Oil Gas J.*, 30.7.56, **54** (65), 176,—A detailed consideration of octane improvement economics is given, and tables show operating costs for reforming, polymerization, alkylation, and isomerization. G. A. C.

1661. A hygrometric chart for high temperatures. K. H. Sambrook. *J. Inst. Fuel*, Aug 1956, **29** (187), 338.—This chart can be used for the solution of drying problems involving high temp. It is based on the Mollier i–x chart as used by Hirsch, but it is extended to 1800° F dry-bulb temp, allowance having been made for the increase of specific heats at high temp. Directions for use of the chart are given. D. K.

BOOK REVIEWS

Structural Geology for Petroleum Geologists. W. L. Russell. London: McGraw-Hill Book Co., 1955. 1p. 427 + x. 56*s* 6*d*.

Over the years numerous books have been published on structural geology, but none of them have seemed especially suitable for the student of petroleum geology. Either they were insufficiently wide in scope or they dealt at considerable length with matters which for a variety of reasons were unlikely to be applicable in oilfield work. Furthermore, the authors omitted to mention, possibly taking for granted, a number of common-sense points to which it is most desirable that the attention of students should be drawn early.

In writing "Structural Geology for Petroleum Geologists" Russell has provided a book which should help the student of petroleum geology to develop the critical approach which is essential if data and the deductions made from them are to be carefully assessed. It is all too easy to note the contouring on a map and to overlook the observations upon which that contouring is based.

The 17 chapters deal with maps and cross-sections, physical principles and model studies, folds, faults, joints and fractures, unconformities, salt domes, buried hills and compaction, sedimentary structures, the structural significance of lithology, regional structures, superficial structures, the structure of continental shelves, dating structural events, the classification of traps for oil and gas accumulation, and structural factors in petroleum prospecting. Over 50 class-work problems are given at the end of the book, and most chapters have numerous references appended in addition to those mentioned in the text.

Since the author intends the book to be used in con-

junction with his previous publication on "Principles of Petroleum Geology," some relevant topics are covered only briefly in the new book, because they have received fuller treatment in the earlier book. On the whole Russell has avoided some of the unevenness which might have arisen in the new book in attempting to minimize overlap.

The presentation is good, and in general the various points are made clearly; the diagrams are well drawn. An appropriately cautious approach has been used in dealing with some ideas and hypotheses, and this, together with comments on terminology and references to the limitations of data and experiments and of the deductions made from them, will be of particular value to a student. Having regard to all these good features, it is most surprising to note a fallacy in the calculation of the closure developed by the compaction of sediments over a buried hill.

"Structural Geology for Petroleum Geologists" can be recommended to all concerned with structural geology, of sediments especially, whether they are studying geology or geophysics. Nevertheless, although probably not high by current American standards, the price of this book may well cause many who would benefit from having it to think twice about buying it. G. D. H.

Chemical Engineering Practice. Vols I and II. Ed. H. W. Cremer, T. Davis. London: Butterworths Scientific Publications, 1956. Pp. xiv + 494; vi + 632. 95*s* each volume.

A series of 12 volumes is planned, covering many aspects of modern chemical engineering. The presentation is intended for readers of graduate standard in pure or applied physical sciences with some mathematical knowledge.

Vol I contains material of a general and introductory nature, some of which will presumably be dealt with in greater detail in subsequent volumes. The opening chapters, tracing the origins of chemical engineering, the chemical engineer, and considering the economics of production, deserve to be read more widely than by chemical engineers alone. The treatment of energy and material balances is similar to that in contemporary textbooks.

In the large section dealing with various aspects of pilot plants, some anticipation of process considerations is inevitable, *e.g.* distillation, absorption, and liquid–liquid extraction. However, an extensive bibliography is supplied. Chapters on the preparation of flow sheets and related calculations conclude the volume.

In Vol II, the solid state, the treatment is more detailed than in the first volume. Crystal structure and mechanical properties of solids are considered largely from the standpoint of electron configuration. The interpretation of the properties of steels and non-ferrous alloys from phase diagrams is well illustrated. The main factors concerning fatigue and creep in structural materials are considered with suitable references for greater detail. The electrochemical nature of corrosion is also well presented with an excellent bibliography. The last half of the book is almost wholly concerned with porous materials and powders. Considerable information in this field has been assembled, and some specific applications are considered: purification of coal gas, treatment of water and sewage, and transpiration cooling.

It is believed that these books will be more useful as a complete series in industrial and academic libraries, rather than as separate textbooks for students. L. G. M.

Selected Combustion Problems. II. Advisory Group for Aeronautical Research and Development, North Atlantic Treaty Organization. London: Butterworths Scientific Publications, 1956. Pp. viii + 492. 90*s*.

The first edition of "Selected Combustion Problems" (*J. Inst. Petrol.*, Feb 1955) appeared in 1954, and comprised the papers presented at the Combustion Colloquium, devoted to fundamentals and aeronautical applications, held at Cambridge University in December 1953. The second Combustion Colloquium was held at Liège in December 1955, and the 18 papers comprising Vol II in the series deal with transport phenomena, ignition, altitude behaviour, and scaling of aero engines. Five of the papers are printed in French and the remainder in English, but each paper is summarized in both languages.

The first two papers appear under a sub-heading of Aircraft Engines and Fuels. The performance of various types of air-breathing unit for aircraft propulsion is discussed, in terms of such factors as efficiency and specific thrust, in order to determine the limiting performance attainable at each aircraft speed and altitude. The treatment of off-design performance is considered in relation to an overall factor, such as total thrust. A broad view is taken of the fuel quality picture with turbojet-powered aircraft, and the major differences between current specified grades are considered to be based upon volatility. The authors infer that, in American aircraft practice, volatility is almost as important to the jet engine as to its parent aircraft. The British view is that, at present, fuel quality is mainly an aircraft problem, and that fuel selection must be based upon such properties as volatility, freezing, and inflammability, in order to give satisfactory service in aircraft fuel tanks and systems, at high altitudes and under extremes of climate. Despite the fact that the aromatic content of all grades of turbojet fuel is limited in order to minimize carbon formation, most fuel deficiencies in the engine have been overcome by continued chamber development. It is true that both aircraft and engine designers alike are becoming increasingly involved with the latest problems set by thermal instability resulting from kinetic heating in supersonic flight, and the growing use of fuel as a heat sink for oil cooling, etc.

The next four papers appear under the sub-heading of Ignition and Flammability, and commence with a study of limits of inflammability based upon the steady-state equation of the combustion wave. A descriptive explanation of combustion wave propagation is given, refreshingly free from complicated mathematical arguments, but the application of the concept of excess enthalpy does not appear to be conclusive. A valuable qualitative contribution is made in the heat balance required for ignition under high altitude conditions. The results of many tests are correlated, showing the influence of igniter design, quenching processes, fuel concentration, mixture movement, etc. Combustion in bi-propellant rocket motors is neatly divided into the categories of initial ignition, subsequent transition involving pressure fluctuations, and final inflammation under constant conditions. Many experimental techniques are described, and some excellent high-speed photographs included showing flame movement in a fully transparent rocket combustion chamber. The paper on thermal ignition, considered at low pressures and high temperatures, throws further light on the long-fought controversy regarding the relative significance of ignition delay and flame propagation in gas turbine combustion chambers. A correlation between ignition temperatures and burning velocities at one millisecond delay suggests that ignition data at high temperatures do reflect flame kinetics.

The next group of three papers is devoted to transport properties, and deals with the fundamental parameters in aerothermochemistry, and the convection of heat at high gas speeds and temperatures. The final paper in this section is of a reference nature, listing numerous published works, research institutions, and other sources of information on the thermodynamic and transport data for liquids, solids, and gases. A most valuable aspect of this paper is the brief summarizing of the contents of many of the references cited.

Four papers are included in the group on high altitude combustion problems. Such factors as turbulent reaction rates, compilation of appropriate parameters for the design of chambers, blowout and relighting under adverse conditions, and dimensional scaling, appear throughout the

papers in this group, but the treatment is sufficiently diverse to avoid repetition. The group is also permeated with a fundamental approach to the basic processes of combustion in gas turbine chambers, and analyses are made of air flow patterns, droplet evaporation, ignition delay, flame speed, and burning processes generally. Emphasis is placed upon the value of accurate determination of combustion efficiency for the analysis, and solution, of altitude relighting problems.

The final group of five papers is concerned with fundamental parameters of similarity and scaling. Combustor development on a pressure-scaling basis is an attractive proposition, but the many variables involved in practice restrict a conclusive demonstration. The concept is re-presented for both vaporizing and atomizing chambers, and the small amount of reliable experimental data so far available appears to be encouraging. Very little information on scaling liquid rocket combustion chambers has been published, due principally to combustion instability, and the two final papers in the book are particularly welcome. Modified forms of the pressure-scaling concept appear to be equally promising for application to rocket chambers.

The advent of jet propulsion has led to a rising tide of combustion literature, and the problems of storage space in personal libraries are becoming acute. The production of concise volumes to focus attention on a variety of current problems, not least through the lively discussions included with each group of papers, forms a major service to all students of combustion who wish to retain a personal copy for frequent reference and study. Their thanks are due to the officers of AGARD for the organization involved, and to the Butterworths publishing house for the clarity of presentation and the speed with which these publications are made available. E. M. G.

The Middle East, Oil and the Great Powers. Benjamin Shwadran. London: Atlantic Press, 1956. Pp. xii + 500. 42*s*.

The attainment of objectivity when writing on the subject of Middle East oil is a rare phenomenon, and the author of this work, a Jew born in Jerusalem who for some years has lived in the U.S.A., is to be commended in that he has at least striven to be fair. He has, however, two hobby-horses, which are, seemingly, ridden in opposite directions. On the one hand, he thinks that the profits made by Western oil companies in the Middle East have been exorbitant; on the other hand, he thinks that most of the Arabs who by their "fifty-fifty" agreements with those oil companies have suddenly become wealthy are radically incapable of utilizing their riches. "The oil resources," he says, "have been swallowed up by the companies and squandered by most of the rulers and governments of the area. The Middle East—with the exception of Turkey and Israel—is being weakened socially; it is politically unstable and economically backward." That is certainly an over-harsh verdict, which makes little allowance for the fact that millions of Arabs were, willy-nilly, pitch-forked from the age of the camel into the age of the aeroplane, and may consequently be, from the Western point of view, a little "off balance."

Nor is Mr Shwadran always fair to Britain. Her insistence that the Mosul vilayet should be included in Iraq derived, he maintains, from considerations of oil—an opinion in which he differs from Professor Arnold Toynbee, whose works he includes in his useful bibliography. Suspicion is one thing, overwhelming evidence is a very different thing. In fact, despite intensive search, very little oil has been discovered in N. Iraq west of the Tigris; and Mr Shwadran surely knows that the presence of oil cannot definitely be prognosticated until the drill has proved what lies under the soil.

On the whole, however, the author does his best to avoid political prejudice, though he has profound doubts whether the Middle East would fight to hold the region for the democratic world as against Communism—his implication being that Israel and Turkey would so fight. Meanwhile, without adding anything really original, his book may be read with profit by those whose study of the problems of Middle East oil is but superficial, provided that they always remember the author's animus against the concessionary companies and against the countries in which they hold concessions. Finally, it may be recalled, when the author writes of the Arabs' doubtful allegiance to this or that concept, that the Zionist movement was ready to take help from any source that seemed temporarily available, whether it was Turkey, Germany, or England, and that it was the combination (for very different, and in neither case, very worthy motives) of capitalist America and Communist Russia which induced the United Nations in 1947 to sanction the creation of Israel. A good many international glasses may be cracked by the throwing of stones, a fact which the supporter of Israel should be the last to forget. Not that the author trails his coat in favour of Israel. His work is deftly done, and should be read with care and patience on that very account. K. W.

High Speed Aerodynamics and Jet Propulsion. Vol. II. Combustion Processes. Ed. B. Lewis, R. N. Pease, and H. S. Taylor. London: Geoffrey Cumberlege, 1956. Pp. xv + 662. 84*s*.

Those who attended the Joint Conference on Combustion organized by the ASME and I.Mech.E. in Boston and London last year will recall two recurrent themes. First, the relatively small contribution which fundamental science appears to have made to the design of the various combustion devices in use today, nearly all of which are the result of empirical development; and secondly, the division of such empirical studies into narrow compartments, with little relation to each other or to the broader fundamental studies. The first theme has perhaps less application to the subject matter of this particular book, the combustion processes involved in jet propulsion, than to the earlier developments of the industrial boiler or of the internal combustion engine. As with nearly all aircraft development, that concerned with combustion has taxed knowledge and ingenuity to the utmost and has necessarily involved a greater dependence on fundamental information. This has stimulated a wide range of combustion investigations, varying over the whole research "spectrum" from the fundamental to the *ad hoc*. The results of this work are well reported in the literature, and particularly in the proceedings of specialized conferences, such as those organized by AGARD and by the Combustion Institute. Nevertheless, such a broad field is covered that the general student must often have felt in need of a key to provide an introduction and background to this work, as well as a summary of recent developments. This role the present book fills with distinction.

The book is divided into 15 sections, each written by an expert. The first group of papers comprises a general introduction on the "Thermodynamics of Combustion," including a full treatment of computational methods of determining the thermodynamic properties of combustion gases and the application of these data to determine performance parameters of the working fluid. The second group of papers is on the "Chemical Kinetics of Combustion." After an introduction by Sir Hugh Taylor, which is a masterpiece of condensation, the kinetics of some individual reaction processes are considered. This is a subject on which the literature is particularly extensive, and the author, after an elaboration of some of the simpler reactions, can do little more than pick out one or two salient points in hydrocarbon oxidation and refer the reader to the literature. It is an unfortunate limitation that, although the practical interest in combustion is in conditions which ultimately lead to high temperatures and rates, almost all of the physicochemical studies have been made at relatively low temperatures where the rates are slow enough to permit

observation. Although the experimental difficulties are great, there is obviously a need for more extensive chemical studies under conditions approximating more closely to those occurring in practical combustion devices. The third group of papers on "Flame Propagation in Gases" comprises a consideration of the mechanics of reaction continua and of combustion waves in non-turbulent and turbulent gases. In this latter chapter Bela Karlovitz gives a particularly valuable summary of the experimental work done in this field and presents a coherent theory to explain the phenomena, which, however, he admits will not necessarily receive universal acceptance. The fourth group of papers on the "Combustion of Liquids and Solids" has a useful section on the utility of solid metal combustion for aircraft propulsion. The various combinations of liquid propellants, both monopropellant and bipropellant, and of solid propellants, both pure explosives and double base propellants, are all considered. There are final chapters on "Detonation Processes in Gases, Liquids, and Solids" and "Energy Production by Nuclear Reactions."

It will be seen from the above description that the particular value of this book arises from the wide range of subject matter covered. Combustion is a subject of interest to the engineer, the physicist, and the chemist, and all three are doing investigational work in this field, but because of their sometimes rather different ways of approaching essentially the same subject, it is not always easy for them to understand each other's work. In this book all three aspects are sufficiently well covered to act as a bridge between all workers engaged in this field.

D. D.

Process Control Analysis. M. H. La Joy and E. A. Baillif. Pittsburgh: Instruments Publishing Co., 1956. Pp. v + 64.

In this world of hustle and bustle, concise treatment of any subject is more than welcome.

One glance into this neat, well-illustrated book will make anyone with the slightest interest in the subject willing to take time off for reading.

Within its pages, the whole foundation of mathematical treatment of closed loop control systems is built up in distinct stages which should aid considerably the following by engineers whose "built-in" mathematical computers are rather out of date, or perhaps in need of a little exercise.

The authors are to be complimented for the sound build-up given to procedure for development of process equations utilizing the electrical analogy, also the simplicity of presentation of the controller equations and their merging into the complete closed loop equations and consequent applications.

An ideal textbook for the student. G. W.

The Mexican Petroleum Industry—1938/50. J. Richard Powell. Berkeley, California: University of California Press; London: Cambridge University Press, 1956. Pp. xiv + 269. 30*s*.

Into this volume is compressed the data and material collected during a visitation of six months in Mexico when all available records and sources of information concerning the Mexican oil situation were studied. The author, as assistant Professor of Economics at Long Beach State College, was eminently qualified to express in lucid language the conclusions drawn from his investigations. 13 chapters are followed by three appendices, a bibliography, and an index, but a single map on p. 54 very inadequately exhibits geographical and other features of a country so rich in mineral oil resources.

In an introductory chapter the author explains that the book had for its object a study of the circumstances which led to the nationalization of the Mexican oil industry and the expropriation of assets held in 1938 by foreign companies, with the subsequent consequences. The arguments used to justify and legalize the summary cancellation of all agreements made by the oil companies with the Government or landowners are based rather on expediency than law, for there was no denial that the discovery of payable oil was due exclusively to the adventurous enterprise of American and British pioneers who overcame enormous difficulties by a lavish expenditure on development. The author endeavours to describe as dispassionately as possible the causes and effects of actions which landed both parties in a series of bitter recriminations that continued for years. It was generally appreciated that should the experiment of nationalization prove successful other Latin-American states would be tempted to follow suit, whereas failure, it was considered, would check any such tendencies.

Chapter II deals with the historical background, which, so far as it concerns oil, relates to the period when Porfirio Diaz as President granted blanket concessions to Sir Weetman Pearson and E. L. Doheny for the exploration of oil in 1901. Foreign capital was encouraged to invest heavily in the development of industries likely to benefit a country without financial resources or skilled technologists. The fact that a wealthy clique of landlords owned vast expanses of land and that an impoverished peasantry were largely in their clutches was no responsibility of the foreigners, who dealt squarely and liberally with those recognized as holders of land. The story unfolded in the succeeding chapters resembles in pattern that of other under-developed backward countries where foreigners were encouraged to embark on enterprises that involved a considerable expenditure of money and hard work on risky ventures.

The discovery of extremely prolific oilfields along the coastal belt of country south of Tampico by both Doheny and Pearson led to a rush of applicants for oil exploration rights, and it resulted in a vast expenditure on roads, dwellings, tankage, pipelines, and refineries to handle a large sudden output of crude. The replacement of Diaz by a revolutionary, Madero, and his subsequent substitution by another ambitious aspirant, Huerta, set in motion a succession of revolts that totally demoralized Mexican life for years. Each president in turn gave unrequited promises of rewards to supporters and of reforms to labour groups. The Huerta regime was overthrown in 1914 by a combination of Carranza, Villa, and Zapata, who then fought amongst themselves for control.

During the 1914–18 war period pressure was exerted on Mexican producers to raise output urgently wanted by the Allies, and this was done in the face of obstacles that seemed insurmountable. Although not specifically mentioned, this result was effected through the activity of a courageous group of American and British employees who stuck to their jobs though suffering untold indignities, insults, and violence from freebooters, blackmailers, and roving bodies of militant revolutionaries who overran the country looting and destroying. As the writer experienced some of those miseries when there in 1919, he can speak with personal knowledge of the corruption, bribery, and illicit exactions levied on oil companies which, if refused, led to wanton destruction of property if not personal violence. A demoralized, rapacious, and recalcitrant labour force stirred up by agitators complicated further the endeavours of the oil companies to extract as much oil as possible for the Allied war cause. Despite obstruction and lack of protection, marvels were accomplished by the major oil companies, although exploration for new fields was naturally restricted by the unsettled state of the country. Charges that the oil companies were scandalously exploiting labour were totally untrue, for never before had Mexican labour been better paid, housed, or fed than in the oil camps.

Carranza eventually overpowered his opponents in 1919, and by promises to labour secured popular support; but on his assassination Obregon took over the Presidency at a critical period when there followed acrimonious exchanges with the U.S.A. as the result of Mexico's refusal to give legality to oil rights acquired by U.S. nationals prior to 1917.

A complicated story follows of lawsuits and other actions taken by successive Federal Governments to abrogate past agreements with the oil companies on the plea that subsoil resources always belonged to the State. Rumours of fantastic profits being earned inspired popular resentment against the oil companies, many of whom would never recoup their capital outlay. Between 1917 and 1921, during the intensive development of the Golden Lane group of oilfields, annual production rose from 55,000,000 brl to a maximum of 193,000,000 brl. From then onwards encroachment of edge water on narrow folds was so rapid that many completions of large potentials by independents turned to water before means could be found for dispoal of oil; indeed, those with disposal facilities benefited at the expense of those without means of removal. By 1930 production had fallen to 40,000,000 brl, when, due to the enterprise of the Royal Dutch Shell Company (Mexican Eagle Group), the Poza Rica oilfield was discovered. This important find of light-density paraffinous oil transformed Mexican oil prospects, for it proved to be one of the world-famous fields with at least three-quarters of the country's oil reserves, estimated at 500,000,000 brl. Between the years 1940 and 1949 this single field yielded 60% of Mexican oil output. Prior to the installation of pipelines for the collection and utilization of gas, it is claimed that at least 25 billion cu. ft. of gas was burnt in flares on this field.

During the Presidency of Cardenas the extravagant demands of labour and the disturbances they caused created conditions of anarchy on the oilfields in 1936, until, driven by popular emotional outbursts, he was induced in March 1938 to announce the nationalization of petroleum, and the expropriation of foreign holdings. At that time two major oil companies, namely, the Royal Dutch (Mexican Eagle Group), and the Standard Oil of New Jersey, jointly controlled 70% of Mexico's oil production.

The confusion that resulted from expropriation and the take-over by Pemex, under which name the nationalized oil industry operated, and the divergent views held concerning its direction, are vividly described, and reference is made to the many factors that obstructed efforts.

On expulsion of the leading oil companies the Mexicans could scarcely expect much sympathy or assistance from them or the governments of the nationals concerned, and their unfriendly attitude did much to embarrass Pemex in its efforts to restore normality. The numerous abortive measures taken by Pemex to instil life into the industry were occasioned by failure to procure oilfield equipment and refinery replacements from abroad, or to negotiate means of distributing oil products internally or abroad. It is shown that to those disabilities were added lack of working capital, inability to negotiate foreign loans, and an organized boycott against export facilities. Other hindrances to progress arose from internal friction concerning allocation of duties and funds for the different branches of exploration, production, refining, and distribution.

In Chapter XI, dealing with financial aspects, and in Chapter XII, headed "Some Broader Effects of Expropriation," which immediately follows one on labour relations, are found some of the most entertaining material bearing not only on Mexican expropriation but on nationalization generally. Only in September 1940 when tempers had calmed and lessons had been learned did indemnification negotiations approach some degree of finality with a payment of $8,500,000 spread over 3½ years agreed with the Sinclair Company. This was followed in 1942 by a settlement with the U.S. Government for a round sum of about $29,000,000, spread over a period for American nationals, mainly the Standard Oil of New Jersey. Not until 1947 was a settlement made with the Royal Dutch Shell interests by a payment of $87,000,000, spread over 15 years, plus interest retrospective since 1938.

Failure of Pemex to earn profits commensurate with those presumed to have been made by the foreign companies was a national disappointment, and attempts to improve matters were frustrated by the dissatisfaction of labour, which now transferred its virulent attacks to the Government. A refusal by the U.S. Government to consider a request for a $200,000,000 loan led the authorities to seek co-operation and finance from private sources. An initial contract was negotiated by Pemex in 1948 with Cities Service (Doherty interests) to supply skilled operatives and suitable equipment for developing oil on the basis of an agreed sharing of produced oil. A second agreement in 1949 was concluded with an independent American oil company domiciled in California.

Having dispelled the idea of confiscation by indemnification on an agreed basis, organized obstruction disappeared, and, largely due to the rapid development of the Poza Rica pool discovered by the Shell group, Pemex gradually improved its position and established normality for an industry fraught with great potentialities.

As a critical study in the economics of the petroleum industry, the book can be highly recommended, and the data so patiently collected and collated about the Mexican oil situation must prove very valuable to the whole oil fraternity.

A. B-T.